

The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

Vol. XV. No. 391

DECEMBER 25, 1926

Prepaid Annual Subscription:
United Kingdom, £1.1.0; Abroad, £1.6.0.

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NOTICES:—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Communications relating to advertisements or general matters should be addressed to the Manager.

The prepaid subscription to THE CHEMICAL AGE is 21s. per annum for the United Kingdom, and 26s. abroad. Cheques, Money Orders and Postal Orders should be made payable to Benn Brothers, Ltd.

Editorial and General Offices: Bouverie House, 154, Fleet Street, London, E.C.4.

Telegrams: "Allangas, Fleet, London."

Telephone: City 0244

A Christmas Greeting

It becomes once more our pleasant duty to wish our numerous readers at home and overseas a Merry Christmas and a Prosperous New Year. The year just closing has been far from a merry period for those responsible for the conduct of business in the chemical as in every other industry. The latter half of it has been, indeed, a period of unexampled anxiety. That the chemical industry has survived it so well is a further testimony to the soundness of its organisation and to the size of its reserves. Whatever may have happened in recent months it is satisfactory that the end of the year closes with a more general desire for industrial peace than has prevailed for some time. The end of the coal strike has come too late in the year to produce much effect upon the business of 1926, but it clears the way for a fresh start in 1927. On every side there is a confident feeling that the New Year will witness a stabilisation of trade conditions, a movement towards peace and co-operation in industry, and a progressive, if gradual, improvement in the national trade position and outlook. It is, therefore, something more than a convention to express to all our readers the hope of a Prosperous New Year. It is a hope that rests on definite grounds and that there is every expectation of seeing fulfilled.

An Important Dyestuffs Decision

THE decision of Mr. Justice Astbury that artists' colours and pencils containing synthetic organic colours come within the provisions of the Dyestuffs (Import Regulation) Act, 1920, may seem a little rigid, but is in strict accordance with the letter of the Act, which forbids the importation, except under licence, of synthetic organic dyestuffs, colours, and colouring matters. The principle appears to be much the same as that involved in the case of gas mantles into which an exhaustive inquiry was made by the Official Referee. It was there held that gas mantles came within the Safeguarding of Industries Act, not as gas mantles, but as substances containing the dutiable rare earth metals thorium and cerium. In this case it is not the pencil that is made dutiable by the decision but the synthetic organic colouring matter that it contains. The case was raised by Whyte, Ridsdale and Co., Ltd., of Houndsditch, fancy goods exporters and importers, who contended that two notices published by the Board of Trade in respect of the importation of artists' colours and pencils were unauthorised and invalid, but no case was made out against the power of the Board of Trade either to issue an original notice or later to amend it as was done in this case.

It is obvious in matters of this kind that a very wide discretion must be allowed to the Department responsible for regulating the import of prohibited substances. In the case of the Safeguarding of Industries Act, the Board of Trade is specifically authorised from time to time to issue lists defining the articles which are to be taken as falling under any of the general descriptions set out in the schedule to the Act. The Board is by no means infallible, and in one way or another its decisions can be referred to a judicial authority. In several of the inquiries under the Safeguarding Act some of the leading authorities on organic chemistry took entirely opposite views of what constituted a fine chemical and whether a particular substance under discussion came within the term "synthetic organic chemical." In this case it was not so much a purely chemical problem as a matter of discretion in deciding whether the imported articles contained a sufficient quantity of prohibited colouring matter to justify action by the Board of Trade. As the Attorney General contended, the question of percentage was not really decisive. The prohibition set up by the Act is absolute except so far as it is qualified by licence, and the question whether the Act should apply to articles containing small quantities of synthetic colouring matter is obviously one for the discretion of the Board of Trade. The opinion of the High Court was taken in this instance to determine the point, and the Judge held that the notices were authorised by the Act. He added, in dismissing the case, the opinion that the action was misconceived.

A Chemical Labour Expert

ATTENTION has frequently been drawn to the excellent relations between employers and workmen in the chemical industry, which has never been better demonstrated than during the recent coal strike. How much this is due to the right handling of workpeople is shown in the record of Mr. T. W. Stuart, who is retiring at the close of the year after 30 years' service as general technical manager and head of the labour organisation in the United Alkali Co. Sir Max Muspratt, who has persistently emphasised the importance of the human factor in industry and whose company has admirably illustrated his precepts in practice, paid at the company's staff dinner last week a deserved tribute to Mr. Stuart's services, especially in this important field. He was able to bear the honourable testimony that there had been no labour difficulties in his long connection with the company that Mr. Stuart had not been able to settle with equal satisfaction to both sides. What is thought of his services by the men was shown some time ago by his election to the honorary membership of the Boilermakers' and Iron and Steel Shipbuilders' Society, one of the oldest trade unions in the country—an incident described at the time as almost unique in British chemical industry.

What has been possible in this case is more or less possible in every industry if not only the right method but especially the right spirit is present. In the Report of the Commission of Inquiry into Industrial Unrest, presided over by Judge Parry in 1917, there is an account of Mr. Stuart's direct methods of dealing with labour without recourse to rigid procedure or printed rules to fetter free and conciliatory discussion. The man who hopes to deal successfully with labour must, in Mr. Stuart's scheme, have eight definite qualifications. He should be of mature years to deal with trade unionists in middle age. He must be absolutely just. He must have his temper always under control. Tact and courtesy should mark all he says and does. He must deal promptly with grievances and applications. He must be a good talker. His door must always be open to his workmen. He must have the sympathy and imagination to be able to see the question from the workman's point of view. These rules are more than mere "tips" to anyone who has to handle workmen; they are largely the principles at the basis of good citizenship. Perhaps it is because of that wider human quality that they have been so successful in their special application to staff management.

The "C.A." Annual Review

THE next number of THE CHEMICAL AGE, to be published on January 1, will be the Annual Review Issue. Until our first Annual Review Number was published on January 3, 1920, no attempt had been made by any chemical journal to give a comprehensive survey of the developments of each year. Our efforts in this as in other respects have since been imitated by others, but our issue of next Saturday will show, we venture to think, that they are content with imitation and little more. Once more we have to thank many old and valued contributors for so readily helping us to make the review of 1926 so representative. Among the principal features will be a study of the chemical

industry generally in 1926 by Sir William Alexander, M.P., who discusses some vital scientific aspects, and Mr. W. J. U. Woolcock, who analyses very thoroughly the productive and commercial aspects. The important subject of nitrogen developments, especially the synthetic branch of the industry, is dealt with by two of our highest authorities—Dr. E. B. Maxted and Dr. F. A. Freeth, chief chemist to Brunner, Mond and Co. The chief points of progress in our national dyestuffs industry are discussed by Mr. R. S. Horsfall, chief colourist to the British Dyestuffs Corporation. Mr. P. Parrish, the author of some of our most authoritative text-books, covers the important field of heavy chemicals. A similar survey of the drug and fine chemical industry is contributed by Mr. C. A. Hill, chairman of British Drug Houses, Ltd. Our competent Patents Correspondent gives the usual valuable digest of the principal chemical inventions of the year, as disclosed in the published patents. In addition to specially contributed reports of the work of the chief chemical and allied societies, there will be a convenient diary of the more important chemical events of the year. Our readers in all parts of the world who have shown so much appreciation of past issues and who carefully preserve them for reference will, we think, find that of Saturday next equally valuable for study and preservation.

Books Received

- EINFÜHRUNG IN DIE CHEMISCHE TECHNOLOGIE DER BRENNSTOFFE (INTRODUCTION TO THE CHEMICAL TECHNOLOGY OF FUELS). Edited by Professor E. Graefe, in collaboration with other authors. Dresden and Leipzig: T. Steinkopf. Pp. 197. Paper, 10 Marks; bound, 11 Marks 50.
- SCHWEFELSAURE, SULFAT, SALZSAURE (SULPHURIC ACID, SODIUM SULPHATE, HYDROCHLORIC ACID). Dr. Bruno Waeser. Being volume XII of "Monographs on Advances in Chemical Technology." Dresden and Leipzig: T. Steinkopf. Pp. 128. Paper, 7 Marks; bound, 8 Marks 20.
- MANUAL OF THE MEDICAL ASPECTS OF CHEMICAL WARFARE, 1926. By command of the Army Council. London: H.M. Stationery Office. Pp. 92. 9d.

The Calendar

Jan.		
3	Society of Chemical Industry (London Section): "Modern Developments in the Treatment of Sewage." J. H. Coste and Col. Butler. 8 p.m.	Burlington House, Piccadilly, London.
4-6	Optical and Scientific Instruments Exhibition.	Imperial College of Science and Technology, London. Bradford.
6	Society of Dyers and Colourists (West Riding Section): "Soledon Colours (SDC) and their Development on Cotton and Wool." Professor F. M. Rowe.	
6	Institution of the Rubber Industry (Birmingham): "Physical Tests and their Significance." A. W. T. Hyde.	Grand Hotel, Birmingham.
7	Society of Chemical Industry (Manchester Section): Short Papers by members. 7 p.m.	16, St. Mary's Parsonage, Manchester.
10	Institution of the Rubber Industry (London Section): "Ageing of Raw and Vulcanised Rubber." G. Martin.	Engineers' Club, Coventry Street, London.
10	Institute of Metals (Scottish Section): Discussion on "The Value of Research." Professor J. H. Andrew. 7.30 p.m.	39, Elmbank Crescent, Glasgow.
11	Institute of Metals (Birmingham Section): "Forces Set Up in Strip Rolling." H. S. Caswell. 7 p.m.	Engineers' Club, Birmingham.

The Therapeutic Dyestuffs.—(I.)

By T. H. Fairbrother, M.Sc., F.I.C., and Arnold Renshaw, M.D., B.S., D.P.H.

Dyestuffs have received great and growing therapeutic application in recent years. In the following article, which is the first of a series, Messrs. Fairbrother and Renshaw, who have a specialised knowledge of the subject, deal with the use of the azo and triphenylmethane dyestuffs in this sense.

THE amount of dyes made for medical purposes is but a very small proportion of the total output of dyes from the standpoint of actual weight. This proportion is, however, a matter of greatest importance to medicine and to the community at large. Some of these medicinal dyes contain in their structures groupings which enable them to be used as powerful curative agents for various purposes. Dyestuffs are used for diagnostic aids as well as for curative purposes. The former contain the microscopic stains, used for the examination of tissues, body fluids, bacteria films, etc., as well as for the indication of certain internal conditions, e.g., the employment of indigo carmine for investigating renal efficiency. The principal rôle of the second class is that of the bactericide. It is probable that the dyestuffs used for this latter purpose act by an actual combination of the dyestuff molecule with the bacteria, thus inhibiting the normal function of the organism.

TABLE I.
Diplobacillus Mirax Axenfeld,
Gonococci, and Staphylococci.

Dyestuff.	Diplobacillus Mirax Axenfeld, Gonococci.	Staphylococci.
Brilliant Green	1 : 5000	1 : 1000
Gentian Violet	1 : 200	—
Hoffman Violet	1 : 200	1 : 1000
Iodine Green	1 : 400	—
Malachite Green	1 : 600	1 : 1000
Methylene Blue	1 : 100	—
Methyl Violet	1 : 200	1 : 1000

TABLE II.
GRAM-POSITIVE. GRAM-NEGATIVE.

	B. Phlei	Staphylococcus	Streptococcus	B. Diptherie	B. Subtilis	B. Anthracis	B. Acid Lactici	B. Coli	B. Dysenteriae (Flexner)	B. Enteritidis (Gartner)	B. Para A	B. Para B	B. Dysenteriae (Shiga)	B. Typhosus.
Benzo Fast Helio ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Chrysoidine ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Chrysophenine ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Chlorantine Brown ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Congo Corinthe ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Congo Red ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Auramine O ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Auramine G ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Chrysamine ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Crystal Yellow ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Crystal Violet ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Dianol Black, Blue ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
2B, Brown and Yellow ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Dianol Fast Claret ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Eosine ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Era Chrome Black ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Fast blue 2B ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Flavine ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Induline ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Meldola's Blue ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Metanil Yellow ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Methyl Violet Z ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Methylene Blue ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Nile Blue A ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Night Blue ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Phenosafranine ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pinks A, R and BK ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pyramine Orange ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Safranine T ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tannin Helio ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tartrazine ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Toluidine Blue ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Malachite Green, citrate and oxalate ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Methyl Violet 2B ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+

The dyestuffs were allowed to act on the bacteria in dilutions of 1:1000.

o signifies that the organisms were killed.

± signifies that the organisms were not killed.

to signifies that over a series of experiments, the organisms were found living in as many cases as they were found killed.

The number of known dyestuffs is very large, and, moreover, wide differences are found in their dyeing properties. From the therapeutic standpoint, similar differences occur. Some dyes are apparently without effect on bacteria, others have a very pronounced action, and others have properties in between these two extremes. There also exists amongst the therapeutically active dyes a certain selective action which renders them useful as bacteriological differentiating agents, as well as for the production of antiseptics. Thus, certain of

the cyanine (q.v.) dyes exhibit an almost incredibly intense action against staphylococci, whilst being comparatively inactive with respect to *Bacillus Coli*. The selective action of various dyes is well shown by Table I.

In Table I is shown the dilutions of certain dye solutions in water which will kill the various organisms indicated. This table illustrates admirably the fact that dyestuffs which may be uniformly active towards a certain type of organism, exhibit widely different activities towards organisms of a different class. In Table II is given a selection of dyes whose action has been investigated on a variety of organisms, and here again the same selective action is evident. Thus Auramine G which will kill streptococci and staphylococci at dilutions greater than 1:5000 fails to kill *Bacillus paratyphosus B* in dilutions of 1:1000. Auramine O, on the other hand, kills both organisms at dilution of 1:5000.

For the present description, it is necessary to consider the dyestuffs as they fall into their various chemical groupings, viz. :—

Azo-dyes.

Triphenylmethane Dyes.

Acridine Dyes.

Oxazines.

Azines.

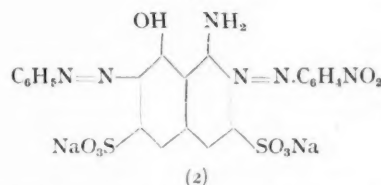
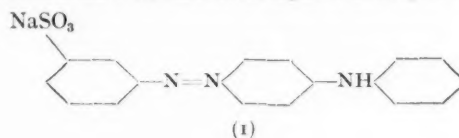
Thiazines.

Phthaleins.

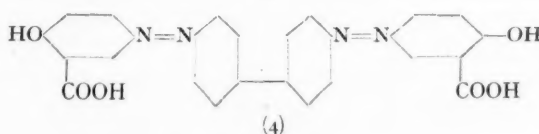
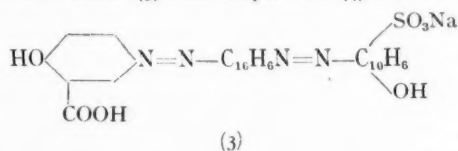
Cyanines.

The Azo-Dyes

As a general class, the azo-dyes show but a weak tendency towards antiseptic action. Thus a typical monazo dye such as Metanil Yellow (1) showed no signs of antiseptic action,



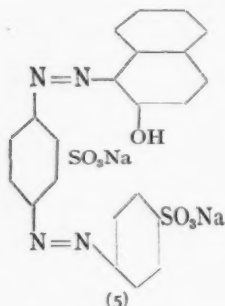
and the majority of disazo dyes (e.g. Blue Black 2) behave in a similar way. Certain of these disazo dyes, notably, Era Chrome Black (3) and Chrysamine (4) show a certain



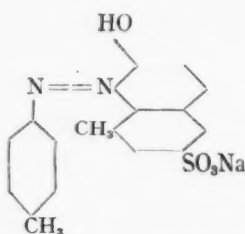
antiseptic action, but this does not appear to be connected with the azo groupings, but is rather due to the liberation of salicylic acid or its simple derivative by the decomposition of the dyestuff (in all probability by the organisms themselves). Among the azo dyes which have found medicinal use, are the

medicinal scarlets including Biebrich Scarlet, Scarlet R, Sudan IV and Sudan III. These compounds are respectively,

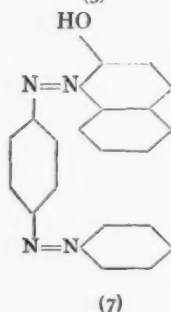
- Biebrich Scarlet (5) Sodium salt of *p*-sulphobenzene azo-*o*-sulpho benzene azo- β -naphthol.
 Scarlet R (6) Sodium salt of xylene azo- β -naphthol, sulphonic acid.
 Sudan III (7) Benzene-azo-benzene-azo- β -naphthol.
 Sudan IV (8) *o*-Toluene azo-*o*-toluene azo- β -naphthol.
 Bordeaux BX (9) Sodium salt of *m*-xylene azo-*m*-xylene-azo- β -naphthol-6-sulphonic acid.



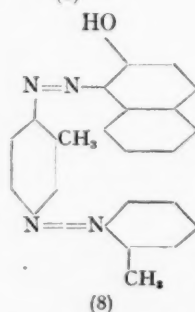
(5)



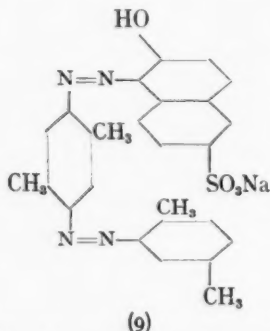
(6)



(7)



(8)

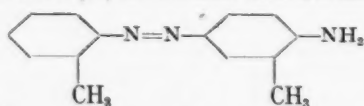


(9)

There is considerable confusion in the nomenclature of these compounds, owing to the similarity of Scarlet Red and Scarlet R. The configurations and names above are those current in England and do not necessarily conform to the continental system.

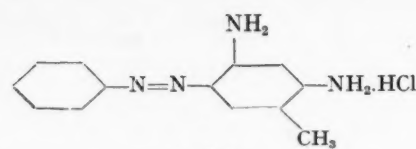
The value of these red dyestuffs lies in their power to hasten the formation of new epithelium, and to assist in the regeneration of the skin. For this purpose, they are put up in aqueous solution or in fatty vehicles as ointments, etc. The precise mechanism of their action in this respect is unknown, but it is in all probability connected in some way with the β -naphthyl nucleus which is known to have stimulating properties when applied to the skin.

Aminoazotoluol (10) has a similar action, as also has its dia-



(10)

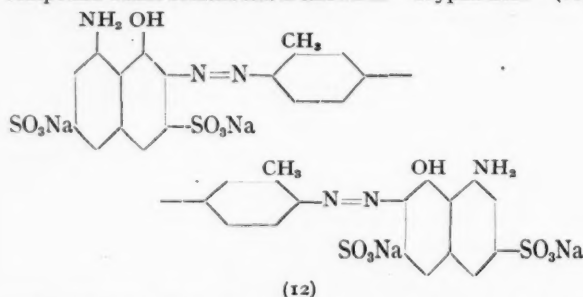
cetyl derivative "Pellidol," but probably the most powerful is Chrysoidin R (11). The presence of the free amino group in



(11)

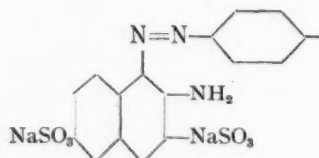
this compound may be connected with its high activity, which is indeed so strong that in some cases it has been known so to stimulate the epidermis that severe dermatitis has set in. This fact, although occurring in but few cases, militates against its extended use in skin treatment. This substance has also a fairly high bactericidal action against *Diplobacillus Morix*, and has a marked, although not powerful trypanocidal action.

The discovery of trypanocidal activity among the soluble diazo dyes containing a free amino group, has led to the synthesis of many interesting substances of the same series which are comparatively strong trypanocides. Thus the combination of tetrazotised *o*-tolidine with two molecules of H-acid (8-amino naphthol-3:6-disulphonic acid) gives a compound whose sodium salt is known as "Trypan Blue" (12)



(12)

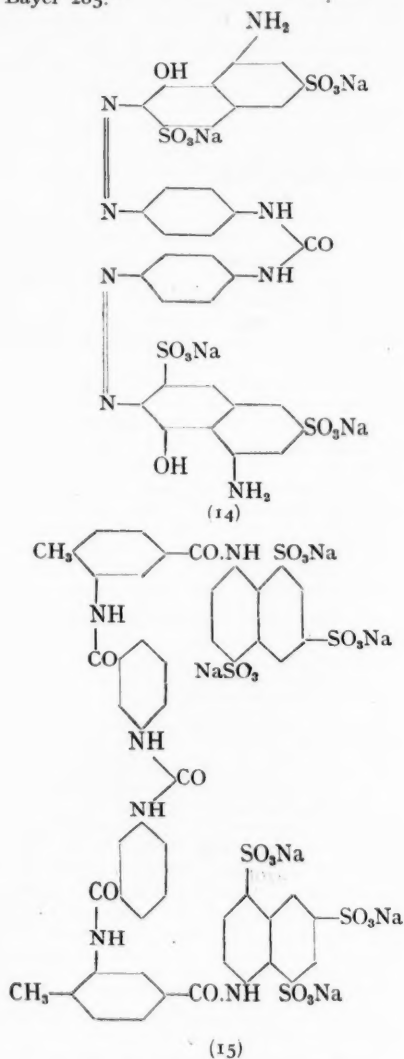
and which has been found to be an active trypanocide, although it is without action on staphylococci and streptococci. Certain organisms nearly related to the trypanosomes responsible for sleeping sickness, nagana, etc. (as well as those responsible for canine piroplasmiasis), are also killed by Trypan Blue, although experiments have shown that its selective action is so restricted that it is without appreciable effect on the organisms responsible for malaria. The use of Trypan Blue in trypanosomiasis is not without certain disadvantages, not the least of which is the likelihood of relapses. Trypan Red (13) obtained by the condensation of tetrazotised benzidine-*o*-sulphonic acid, with naphthylamine 3:6 acid, has similar properties and disadvantages.



(13)

The introduction in 1906 of Afridol Violet (14) marked a significant advance in the introduction of the highly complex substituted derivatives of urea for the treatment of trypanosomiasis. Its importance lies not in its own properties (which although trypanocidal are not sufficiently so to render its use advisable), but in the fact that it has led to the discovery

of the compounds of the type Bayer "205," and its even more valuable successors. "Bayer 205" was, at the time of its inception, probably the most powerful trypanocide known, and even now its constitution is not generally known with certainty. Formula (15) is that of the similar compound "Forneau 309," which is maintained by some to be identical with "Bayer 205."

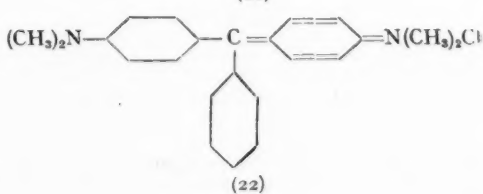
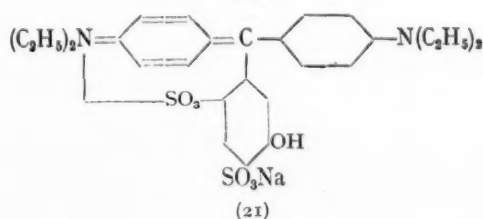
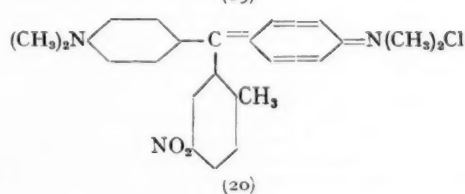
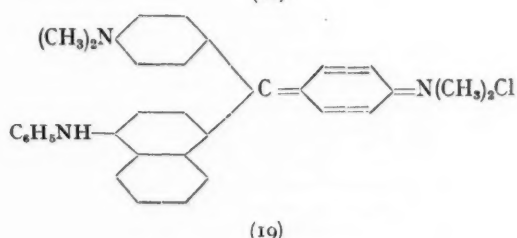
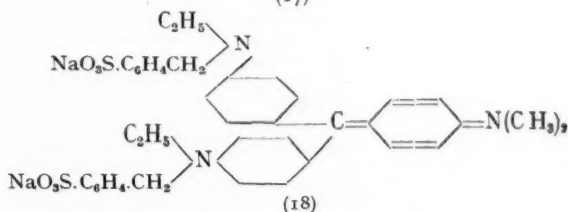
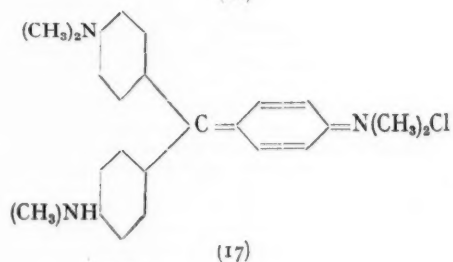
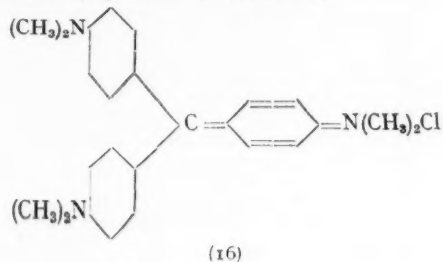


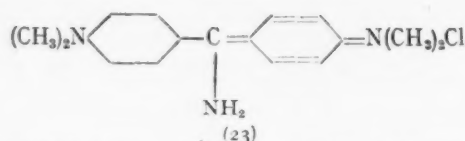
The Triphenylmethane Dyes

The activity of certain of the triphenylmethane dyes as bactericides has attracted numerous workers to the field. At one time the most widely used of these was Crystal Violet, on the uses of which in medicine over a thousand papers have been written. The substance has the formula shown in (16), and was used as a starting point by the authors in a series of investigations arising out of an attempt to correlate chemical constitution and bactericidal action.

The first question that arises in the consideration of the cause of activity of Crystal Violet is that of the influence of the nature of the substituents of the hydrogen atoms attached to the nitrogen atom. The removal of a methyl group as in methyl violet (17) is attended by little or no change in activity, but the substitution of the simple methyl groups by heavy side chains as in Formyl Violet (18) leads to a considerable diminution in activity, as also does the replacement of one of the amine residues by a substituted naphthylamine group, as in Victoria Blue B (19). A surprising fact was elucidated in that the introduction of a nitro group in place of the dialkylamino residue (Turquoise Blue G (20)) almost completely destroyed the bactericidal activity of the

compound, a similar state of affairs being also arrived at when naphthalene disulphonic acids or naphthol sulphonic acids were used to replace one of the aniline residues. Further, Patent Blue V (21) is also without action.





Crystal Violet (22), however, is quite active, and more drastic simplification of the molecule leads to Auramine (23), which is the most efficient compound of the series.

Auramine is probably the most potent antiseptic dyestuff

known (with the possible exception of certain of the cyanine dyes), and one which is, moreover, very general in its action. It inhibits the growth of all tested organisms at a dilution of 1 in 5,000, and even at 1 in 250,000 it inhibits the growth of *Micrococcus ureæ* to such an extent that its use in public lavatories, etc., would conduce very considerably to their hygiene. Auramine, moreover, is cheap, when compared with the fabulously expensive cyanine dyes and the acridine dyes such as acriflavine, and can readily be obtained in the form of a stable solution ("Glauramine") which is receiving considerable attention as an antiseptic in human and veterinary medicine.

The Synthesis of Petroleum

By Dr. Franz Fischer

At the International Conference on Bituminous Coal which took place at the Carnegie Institute of Technology, Pittsburgh, recently, a number of very important papers were read. We give below the essential parts of that read by Dr. Fischer, Director of the Institute for Coal Research at Mulheim-Ruhr, Germany, which will be followed in due course by others.

THE purpose of my lecture is to give an illustration of the synthesis of petroleum as it has been carried out by Tropsch and myself. It is possible to produce petroleum-like products from the bitumen of coal, peat and oil-shale, and from waxes and fats by decomposing these materials through distillation at low temperature with or without pressure. But as a substitute for natural petroleum, which is lacking in many countries, these raw materials can only partly be taken into consideration. It is by no means my intention to say anything against the practical importance of the distillation of bituminous coal at low temperature. On the contrary, I am convinced of its great future. But in the methods of distillation the resulting low temperature tars or oil are quantitatively only by-products of the process. Quantitatively the chief product consists of the residues of distillation, that is, of the semi-coke upon whose possible utilisation the further development of these processes depends; this is in the field of smokeless fuel, of powdered coal and of water gas. An industry that intends to manufacture petroleum-like products as its chief product must, however, pursue a different course. The application of heat alone is not sufficient.

Hydrogenation Methods

If one attempts to obtain petroleum-like hydrocarbons from unaltered coal there can be considered, at present, only the action of hydrogen at high pressure and at high temperature. Not only is oxygen probably withdrawn and hydrogen added to the different kinds of molecules of which the coal is composed, but there takes place along with the decomposition of the molecules and the hydrogenation a reduction in size of the large molecules of the coal originating from the humic acids. The products of this process are hydrocarbons with the most varying boiling points, and liquid substances containing oxygen.

Bergius and Billwiller succeeded in 1913 in solving the problem of the conversion of coal into petroleum-like products in a way which is industrially practicable. In this one proceeds with hydrogen under a pressure of about 200 atmospheres and at temperatures of from 400° to 500° C., and one obtains up to 50 per cent. of the weight of the coal in a tar-like oily mixture and gasoline. The main part of the mixture, namely, the hydrocarbons, are predominantly of cyclic and, to be more specific, of hydro-aromatic character. The smaller part of the oil mixture consists of aromatic substances containing oxygen, viz., phenols. According to the statement of Bergius, the low-boiling parts, also the finishing of his method, consist of hydro-aromatic compounds. The hydrogenation under high pressure of Bergius and Billwiller begins with unaltered coal and ends with a mixture of cyclic compounds.

Contrary to that method, not only in regard to raw materials, but also as to the manner of procedure and the products, are the building-up syntheses, namely, those methods which attempt to form the larger molecules from the smaller ones.

In the years following the methane synthesis of Sabatier and Senderens, Haber's high pressure synthesis of ammonia from nitrogen and hydrogen was carried out on a technical scale in the Badische Anilin- und Sodafabrik. Therefore, it was quite natural to begin with the catalytic hydrogenation

of carbon monoxide, using the exceptionally effective high pressure method. According to the German Patent 293,787, taken out in 1913 by the Badische Anilin- und Sodafabrik, a mixture of hydrogen and carbon monoxide, with a surplus of carbon monoxide, was brought into reaction under pressure of about 120 atmospheres and at temperatures of about 400°, using different catalysts. From this a liquid reaction product resulted which was composed of an oily and a watery layer. The former consisted chiefly of hydrocarbons, which were about two-thirds of a saturated character and one-third of an unsaturated character. Some dissolved organic compounds of oxygen of different kinds were present in the oily layer. By special purification methods, it was said, a product could be obtained which had a petroleum-like character.

Synthol from Carbon Monoxide

In our institute, my collaborator Dr. Tropsch and I studied thoroughly the hydrogenation of carbon monoxide under high pressure. In order to avoid the easily occurring deposition of carbon by the so-called splitting of the carbon monoxide ($2 \text{ CO} = \text{C} + \text{CO}_2$), we worked, however, not with a surplus of carbon monoxide, but whenever possible with a surplus of hydrogen. Alkalised iron proved to be the best contact substance. We found all kinds of new and partially divergent results in comparison with the statements of German Patent 293,787. The oily layer did not consist of hydrocarbons but almost exclusively of aliphatic higher alcohols, ketones, and aldehydes, besides some higher fatty acids. To this mixture the name synthol was given. The strength of the base, with which the iron contact substance was alkalised, is of influence on the composition of the product. With weak bases, only the watery layer is obtained, which layer contains lower alcohols and ketones. Upon alkalisating with strong bases the composition was carried higher and higher. Starting with carbon monoxide we obtained, at that time, molecules with about nine atoms of carbon.

Shortly after this, the Badische Anilin- und Sodafabrik put into practice the high pressure synthesis of methyl alcohol. We ourselves were not interested in the synthesis of methyl alcohol, because we aimed to produce motor fuels out of carbon monoxide. For this purpose even ethyl alcohol is not suited; still worse is methyl alcohol. On the other hand, we found that the higher alcohols which are present in synthol can very well be utilised as motor fuels.

Tropsch and I finally found the way to produce, without use of pressure, the liquid and solid saturated hydrocarbons of the petroleum series from carbon monoxide and hydrogen. In this there appeared no compounds containing oxygen, while in the pressure method with carbon monoxide and a surplus of hydrogen only products containing oxygen were made. It seems almost enigmatic that Sabatier and his collaborators did not find the same twenty-three years ago, when they showed that carbon monoxide or dioxide could be quantitatively reduced to methane in the presence of nickel.

The conditions for the formation of methane are unfavourable for the synthesis of the higher hydrocarbons from carbon monoxide. We published one part of our results this spring, as far as it seemed necessary for us to assure our

priority in scientific research. We solved the problem of the purification of technical gases in a simple manner, and the durability and possibility of regeneration of the contact substances left nothing more to be wished. The fear has been expressed that the apparatus would become too large if the work proceeded at atmospheric pressure. But it has already been correctly pointed out that no one would think of performing the cheaply working contact process for the production of sulphuric acid under higher pressure in order to get smaller tube diameters and smaller apparatus.

The Most Recent Results

Since our publication in April we have conducted experiments to see whether there might be any difference in regard to the results and in regard to the durability of the contact substances, when we used alternately synthetic gas and technical water gas purified according to our method. The synthetic gas was obtained by mixing electrolytic hydrogen with carbon monoxide, the latter being generated by dropping formic acid into heated concentrated phosphoric acid. The result of these comparative experiments was excellent, since both kinds of gases acted exactly in the same manner, not only temporarily but permanently. We used chiefly water gas for our synthesis. But equimolecular proportions of carbon monoxide and hydrogen are not absolutely necessary. Other ratios of combination are possible too. Even generator gas and blast furnace gas can be employed, especially if they are corrected by the addition of hydrogen, naturally with the supposition that they are freed from contact poisons.

As catalysts we used, in contrast to Sabatier's synthesis of methane, generally, not nickel, but cobalt or iron. The process can be carried out without activating admixtures of any kind, for example, with finely divided iron alone, or with finely divided cobalt alone. An essential characteristic of our method is the use of temperatures that are too low for the formation of methane. The inertness of reaction produced thereby was balanced by the most careful preparation of the catalysts. Formerly we had to regenerate the contact substances from time to time; to-day we know the conditions under which they become better and better by themselves. The temperature must always be below the temperature that is advantageous for the formation of methane in case of the catalyst in question. In general, the lower the temperature the more favourable the result. The range of temperature lies between 200° and 300° C.

The Nature of the Reaction

The products present in the reaction gas, namely, gasol, gasoline and vapours of petroleum and solid paraffin, can be imagined as having originated in different ways. If we imagine that 1 CO is reduced to the group CH_2 , then the oxygen derived from the CO is met again in the form of water, or as carbon dioxide. Also the simultaneous appearance of water and carbonic acid is conceivable. In fact, the process can be arbitrarily so conducted that in addition to the higher hydrocarbons formed out of the CH_2 groups with simultaneous hydrogenation, either water or carbonic acid or both appear in the gas. It can be arranged thus, that after an eventual removal of the carbonic acid the gas leaving the contact, with reference to the part not yet converted, possesses the desired relation of hydrogen to carbon monoxide.

Generally an approximate 50 per cent. yield can be obtained with a single passage over a good contact substance, and then the choice presents itself either of passing the rest of the gas for a second time over the contact after the removal of the products of the reaction, in so far as they do not separate by themselves—for this purpose active charcoal or silica gel may be used, as is done on a large scale in the American natural gasoline plants—or by using it in any other way, *e.g.*, transforming it into illuminating gas, etc. The quantitative ratio of the mentioned products of reaction can be influenced, the simplest thing being to produce gasol, a mixture of ethane, propane and butane, that could be easily compressed and liquefied. It required much work to find the conditions under which, instead of gasol, higher homologues, namely, the gasoline hydrocarbons, appeared in a good yield. It is relatively easier to achieve the synthesis of solid paraffin than to perform that of gasoline. In case of the presence of strong bases the polymerisation continues until solid paraffin is reached. Therefore the impression is formed that polymerisation, once begun, tries to go on at once to the end, and that certain dif-

ficulties present themselves to stop it at hydrocarbons of molecules of medium size, *e.g.*, gasoline.

These samples show, for one thing, how the raw materials looked, for the contents are in the original state, as obtained from a small experimental plant. The clear yellow oil in the first bottle is the petroleum fraction which separated by itself in the condenser of the apparatus. The second bottle contains all high-boiling parts that leave the contact tube with a small quantity of lubricating oil and a more abundant quantity of solid paraffin, of which one part has already settled. The contents of the third bottle have simply been blown off with the steam, according to the usual method, from activated charcoal that served for the absorption of the gaseous gasoline. It is clear as water and in quality it corresponds to the so-called best gasoline *de luxe*.

We have not yet a world oil famine, but when it comes, there will be available methods for overcoming it by means of the newer chemistry of coal. More than 100 g. of solid, liquid and easily liquefiable hydrocarbons to each cubic metre of water gas can be obtained if the gas is conducted several times over the contact. Although we may assume that in the course of time the conditions may be worked out still better, it is most practical at the beginning to make the process an intermediate process in water gas plants, to take out the benzine, and to continue to use the gas then left as formerly. Then only that water gas is to be considered as used for the gasoline which really disappeared at this time, and in this manner we arrive at the most favourable calculation, since then one has a theoretical yield. Moreover, there exists the possibility of approaching the theoretical yield of 780 g. per cubic metre by reconverting the hydrocarbons as methane and gasol that originated, perhaps, without being desired, during the process, by heat treatment, or, as the case may be, the addition of steam or carbon dioxide into water gas, and conducting it once more over the contact. Of course, for economic reasons, the most valuable coke will not be used for this purpose, but the grades of coal and coke that are the cheapest and out of which the water gas can be produced at the lowest prices.

The largest gas generators which the industry has at its disposal are the blast furnaces, the waste gas of which is relatively pure, especially in regard to sulphur, and could be used, too, for the production of gasoline if hydrogen were added or if a part of its carbon monoxide were replaced by hydrogen. Natural gas or methane of any other origin can be used for gasoline production according to our method, if they are first mixed with steam or CO_2 and then heated to such a degree that water gas is formed.

As to the theory of the process, it is beyond any doubt that the contacts used absorb carbon by formation of carbides. We imagine that carbides richer in carbon than Me_3C are temporarily formed and are split up into higher hydrocarbons by the hydrogen mixed with CO. If, however, pure hydrogen is conducted over mixtures of carbides first produced with carbon monoxide, scarcely anything but methane appears. Perhaps hydrogen in the absence of carbon monoxide hydrogenates these carbides too much. The reason why the metals of the iron group are especially suitable as catalysts may be that they combine the property of forming hydrides and carbides at rather low temperatures; but it may be, too, that the calorific effect for the formation and the decomposition of the carbides is especially favourable. The formation of the above carbides rich in carbon is very probable indeed. But up to now such carbides in a pure state have not been isolated.

Synthesis of Thyroxin

It is announced that Dr. C. R. Harington, of University College, London, and Professor G. Barger, of Edinburgh University, working in conjunction, have succeeded in synthesising thyroxin. This substance is the hormone produced by the thyroid gland. Excess or defect of it, resulting from defective functioning of the gland, give rise to a variety of abnormalities in the human body, such as goitre, stunting of growth, and mental disturbances. Thyroxin, which was first isolated by Dr. Kendall, of the Mayo Clinic of the United States, shows great potency in physiological action, and in view of the fact that it can only be obtained from natural sources in very small quantity, its synthesis, with presumably a great lowering of cost, should be of great medical importance.

A Note on the Formation of Elements

To the Editor of THE CHEMICAL AGE.

SIR,—The rarity of the rare gases has been commented upon before as being in itself a phenomenon which was remarkable (e.g., Aston, *Nature*, November 29, 1924). An explanation of it as well as of several other independent phenomena can be offered on the hypothesis that the evolution of elements from the primordial protons and electrons takes place by the following steps:—(a) An initial combination to form rare gas nuclei; (b) the synthesis of the nuclei of the remaining elements by the rare gas nuclei, the protons and the electrons combining amongst themselves.

Table 1 illustrates the results to be expected from this hypothesis, any element marked in it being obtained by the combination of the isotopes of the rare gases given in the first row vertically above it and the column in its line to the extreme

(4) The stellar spectra show, as we proceed from the hot B type stars to the cooler M type the emergence in succession of the elements H, He; Si, O, N; Ca, Mg; Fe, alkalis and alkaline earths; other metals.

(5) In the stage of formation of early nuclei, these will preponderate proportionally in the composition of the body. As further stages are attained, newer elements are formed, and thus the former diminish in proportion. An example is the preponderance of Si and O over Fe, Ca, etc., in the composition of the B and A types of stars; and then, the gradual ascendancy gained by the latter over the former as we proceed to succeeding types, as in the sun. But, proceeding still further, we find in the earth this ascendancy once again greatly reduced (cf. Miss C. E. Moore and H. N. Russell, *Astr. Jour.*, 43, I, p. 12); which, perhaps, finds an explanation in the considerations put forward below.

(6) Any stage of formation would represent an equilibrium

	H ¹	He ⁴	Ne ^{(18), 20, 22}	A ^{(34), 36, (38), 40}	Kr ^{78, 80, 82, 83, 84, 86}	Xe ^{134, 136, 138, 139, 140, 141, 142, 144}	Radon 222
H	—	—	F ¹⁹ Na ²³	Cl ^{35, 37} K ^{39, 41}	Br ^{79, 81} Rb ^{85, 87}	I ¹²⁷ Cs ¹³³ (Te ¹³⁰)	—
He	—	—	Mg ^{24, 26}	Ca ^{40, 44} A ^{38, 40}	Sr ^{86, 88} Kr ^{86, 84, 82} Zr ⁹⁰	Ba ¹³⁸ Xe ^{128, 130, 132, 134, 136} Cs ¹³³ Ce ¹⁴⁰	Ra ²²⁶
Ne	—	—	Ca ^{40(2), 44} A ^{36, 38, 40(2)}	Fe ^{54(2), 56(3)} Ni ^{58(3), 60(2)} (Co) Cr ⁵²	(Rb, Rh, Pd)	Rare earths (of atomic wts. from 142 to 158)	—
A	—	—	—	Zn ^{68, 70} Se ^{74(2), 76(2), 78, 80} Kr ^{78, 80} Ge ⁷⁴⁽²⁾ (As)	Sn ^{116(2), 118(4), 119, 120(4), 122(3), 121, 124(2)} Cd ^{112, 114(2), 116(3)} Sb ¹²³ Te ¹²⁴ Xe ¹²⁴	Rare earths (of atomic wts. between 158 & 176)	—
Kr	—	—	—	—	Rare earths (Atomic weights between 156 and 176)	Radioactive elements. (Atomic weights, 202 to 222)	—
Xe	—	—	—	—	—	Unstable nuclei	—
Radon	—	—	—	—	—	—	—

TABLE I.

left. The isotope values are marked in figures, and are those given by Aston (*Phil. Mag.*, 49, p. 1198). The isotopes 18, 34, 38 have been included to complete the comparisons between the formations of halogens; though it is not indispensable to do so. The formation of an isotope by two or more independent combinations of the same rare gases is shown by the corresponding number in brackets following the isotope number (e.g., Sn¹¹⁸⁽⁴⁾ denotes its formation from the following combinations:—A⁴⁰+Kr⁷⁸, A³⁸+Kr⁸⁰, A³⁶+Kr⁸², A³⁴+Kr⁸⁴). The table shows the elements formed by the combination of two nuclei only, and hence expected to be commonest, excepting, sometimes, when the synthesis is more complex but is of lightest nuclei (e.g., Si, O, etc.).

The following consequences of such an arrangement are to be expected:—

- (1) The parent nuclei—those of the rare gases—are rare.
- (2) Elements resulting from syntheses of nuclei of increasing mass have increasing rarity and instability.
- (3) Isotopes of similarly formed elements show similar mass-spectra; e.g., the remarkable similarity between the mass-spectra of Sn and Cd, and Se and Kr, observed by Aston (*Phil. Mag.*, 49, p. 1196), even though the pairs have not all the isotopes in common.

process, as many atomic nuclei being formed as are disintegrating at any instant. The conditions for synthesis would be governed by the physical conditions, such as temperature, pressure, etc., of the surroundings only; while disintegration can take place due to these same conditions as well as the internal forces brought into existence within the nucleus. Heavier nuclei would be more complex and hence more unstable; therefore, these are more liable to disruption through the latter cause. A case in point is that of radioactivity. The presence of the radioactive elements in the stars as seen from their spectra, is extremely doubtful, while in the earth, they are believed to be concentrated in the upper crust only. This would show a late start and an early inhibition of their formation after the separation of the earth from the sun. The present day radioactivity is a phenomenon showing the disintegration of heavy nuclei due to instability only, while the process of formation has already ceased.—Yours, etc.,

M. F. SOONAWALA, M.Sc. (Allahabad).

Physics Department, Maharaja's College,
Jaipur, (Rajputana), India.

September 30.

Tar Standardisation

To the Editor of THE CHEMICAL AGE.

SIR,—Practically every interest in the tar producing and using communities in this country was well represented at the Tar Conference held at Manchester on Friday, November 26, when the following resolution was unanimously adopted: "That the Joint Committee consisting of the Fuel Section of the Society of Chemical Industry, the Coke Oven Managers' Association, and the Institution of Gas Engineers be requested to devise means for the formation of a representative committee which shall standardise as far as possible the methods of testing tar and its constituents."

It was generally agreed that the Committee that should eventually deal with the matter should be as representative as possible, and it will be the aim of the joint committee to ensure this.

This letter will be sent to all those who are thought to be interested in the subject, but it is certain that many will be overlooked; consequently its appearance in the technical press is an invitation for them to communicate with the hon. secretary of the Joint Carbonisation Committee, Allington House, Victoria Street, London, S.W.1.

As a first step, all chemists and others who are interested in the subject of the standardisation of methods of testing tar and its products are requested to communicate with the hon. secretary, informing him of the particular tests that they individually have in mind that require standardisation. The committee will then not only have a starting point, but they will also be put into communication with all those who are showing an interest in this subject, and will be in a better position to make a representative selection without serious omissions than if they depended on their own immediate experience and knowledge.—Yours, etc.,

E. W. SMITH,

Joint Hon. Secretary of the Joint Committee.

Oil from Coal

To the Editor of THE CHEMICAL AGE.

SIR,—In your issue of December 18 is a paragraph under the head of "Distillation of Inferior Coals," in which Sir P. Dawson is credited with having referred to "millions of tons of Cannel coal dumped around the Scottish mines." I was present at the session of the Institute of Fuel Technology, and have before me the verbatim report from the special issue of *The Fuel Economist*, but I cannot trace the words as you have given them. Sir P. Dawson is reported to have said, "there were large dumps—millions of tons—around the Scottish mines which an analysis he had had made showed to contain anything from 20 to 30 gallons of oil to the ton." He leaves it to be inferred that these dumps contain a proportion of mineral belonging to the Cannel group. But this is quite a different statement to that which you have attributed to him. Even as it stands, the statements made are remarkable.

The Scottish oil industry began operations many years ago on what were called Cannels, but as the industry grew and the supply of good-grade Cannel diminished, they had to utilise shales of a much lower oil-producing tenour. According to the *Board of Trade Accountants' Report*, 1925, and *THE CHEMICAL AGE* (27/2/26, pp. 199 and 200), the grades operated in 1925, in eight of the twelve works, averaged less than 20 gallons of crudes per ton of mineral treated. On this report it was decided to close down some of the works. But now we are told that there are millions of tons of mineral on Scottish dumps, "eminently suitable for distillation," which can be had "practically for the asking," and which contain "from 20 to 30 gallons of oil to the ton." Some better Torbanites and Cannels are said to be available in the same locality which yield 70 and 80 gallons of oil per ton. But, if so, we should like to know why Scottish Oils, Ltd., have not utilised some of this mineral, bearing in mind the relative poverty of their own supplies. If it can be had for the asking, the cost of delivery to their works (or to some of them) should not have exceeded the 7s. 3d. per ton which their own shales cost them. On the face of these statements, it looks as though some very important qualification had been omitted by the authors of them.

During the discussion on the low temperature carbonisation

question, the chairman warned the meeting that one might be seriously misled unless the speakers were very specific as to the coals they were referring to, the source of the tars, and so on. This warning should be broadcast.

I have not seen the *Survey of the Cannel Coals of Great Britain*, said to have been made by the Petroleum Research Department of the Admiralty in 1917, but one would think that its contents would have become known to Scottish Oils, Ltd. during the next 8 or 9 years, especially as the latter were then contractors to the former. Yet all this Cannel coal has remained, as we are now told, unused for production of oil. It is very strange.—Yours, etc.,

A. WORSLEY.

United Alkali Manager's Retirement

Mr. T. W. Stuart's Remarkable Career

AFTER more than thirty years' service as general technical manager and head of the labour organisation in the United Alkali Co., Ltd., Mr. T. W. Stuart, a well-known figure in Liverpool business circles, is retiring from his position at the end of this year. Mr. Stuart was elected a director of the company on Thursday, December 16, at a meeting of the board, in recognition of his services, not only to the company, but to British chemical industry in general. Special reference was made to Mr. Stuart's understanding of labour problems by Sir Max Muspratt at the United Alkali Co.'s staff dinner on Tuesday, December 14. In proposing Mr. Stuart's health, Sir Max referred to his great services to the company and to the chemical industry throughout the kingdom during the past sixty years. There had been no difficulties over strikes, or on any question connected with the workers, which Mr. Stuart had not been able to settle to the satisfaction of all concerned. During his sixty years' experience of labour problems, Mr. Stuart had studied the workmen absolutely and completely, and had used his accumulated knowledge to the mutual benefit of his firm and their employees.

Mr. Stuart received his scientific education at Edinburgh University, after which he entered, in 1866, the service of Allhusen and Co., on Tyneside. He next joined the firm of Tennant and Co., as general technical manager of their works in Glasgow, Newcastle, and Middlesbrough. It was in 1895 that he came to Liverpool and joined the United Alkali Co., Ltd., as its general technical manager, a position which he has held ever since. As head of the United Alkali's labour organisation, Mr. Stuart has established a splendid reputation for his share in holding the scales evenly between the company and the trade unions. His policy has been to make himself immediately accessible to employees at all times, so that applications for advances in wages or for the adjustment of any small difficulty can be dealt with without a day's delay. In this way he has earned the respect and gratitude of the thousands of employees of his firm. In March of last year Mr. Stuart was elected to an honorary membership of the Boilermakers' and Iron and Steel Shipbuilders' Society, one of the oldest trade unions in the country. This was the highest honour the society could bestow, and was described at the time as being unique in the annals of the British chemical industry.

Decomposition of Synthetic Ammonia

At the instigation of the German Refrigerating Association, Professor von Wartenburg has carried out at Danzig experiments on the decomposition of synthetic ammonia. The latter is used on a large scale, just like gas ammonia, in refrigerating processes; and observations had been reported in the case of a refrigerating plant indicating the accumulation of large amounts of gas, which was attributed to decomposition of the ammonia. But, according to Dr. Müller of the I.-G. Farbenindustrie A. G., this is not the case. In laboratory experiments ammonia was heated to 180° and 300° in an autoclave of 3 litres content without differences being observed between synthetic and gas ammonia. Dr. Vogt points out that in testing the great refrigerating plant of the Gewerkschaft Kaiserroda for leaks a sulphur match is generally used, without explosions having taken place anywhere so far, in spite of the great amounts of ammonia present.

Recent Books on Colloid Chemistry

AN INTRODUCTION TO SURFACE CHEMISTRY. By E. K. Rideal. Cambridge, at the University Press, 1926. Pp. 336. 18s. net. (1).

THE HYDROUS OXIDES. By H. B. Wiser. London: McGraw-Hill Publishing Co., Ltd., 1926. Pp. 452. 25s. (2).

NEW CONCEPTIONS IN COLLOIDAL CHEMISTRY. By Herbert Freundlich, Ph.D. London: Methuen and Co., Ltd. Pp. 147. 6s. (3).

PRACTICAL COLLOID CHEMISTRY. By Wolfgang Ostwald. Translated by I. Newton Kugelmass, M.D., Ph.D., Sc.D., and Theodore K. Cleveland, Ph.D. London: Methuen and Co., Ltd. Pp. 191. 7s. 6d. (4).

(1) The first and larger part of this work deals with the phenomena at the interfaces of two phases. Definition of surface tension and surface energy is followed by a clear account of the principal methods of measurement, in which recent work like that of Ferguson and of Sugden is fully considered. The deduction of the Gibbs equation is then given, and the attempts to verify it experimentally are discussed exhaustively and critically. Then follows the most interesting portion of the work, that dealing with the actual structure of the interfacial film, as elucidated by the work of Hardy, Langmuir, Harkins, Adam, and the author himself. "The combined effect of these researches," as Prof. Donnan says in the preface, "has been to reveal the existence of a newly recognised so-called 'two-dimensional molecular world' the structure of which 'presents new phenomena of molecular orientation of the highest importance for the understanding of great regions of natural phenomena.' The present work is the first text book to give a connected account of this vast subject, and does so with admirable lucidity and completeness.

The application of this new knowledge to colloidal systems, in which the nature of the interfaces is still very obscure, will not be an easy matter. The second part of the book is, as Dr. Rideal says in his introduction, "admittedly incomplete as a compendium on colloid chemistry"; largely so, because the author has chiefly confined himself to those aspects of the subject which have been amenable to mathematical treatment. Conditions in colloidal systems are so complicated that mathematical treatment involves even severer simplifications than in most branches of physics, or has to begin—as in the theory of coagulation velocity—where a process has lost its chief physical interest. The author seems a little more convinced of the existence and importance of "fibrillar" elements in sols and gels than the evidence warrants; the problem of variable viscosity can certainly not be disposed of by such assumptions.

A few obvious slips will be easily corrected in future editions. Laplace's theory of surface tension (p. 23) does not assume a "diffusive gradient of properties," but discontinuity between liquid and vapour; a closely packed assemblage of equal spheres is transformed, by increase in number or size, into an assemblage of rhombo-dodecahedra and not of pentagonal dodecahedra, which do not fill space (p. 109), and the author of several important papers on the Gibbs theorem, emulsions, etc., is called Lewis and not McLewis (pp. 36, 106, 168). The printing and binding conform to the usual high standard of the publishers.

(2) This is an interesting and useful book. The author's thesis is that the great majority of the hydroxides, for which formulae are given in the text books, are not definite hydrates at all, but mixtures of oxide and water in ratios which vary widely with the method of preparation and the age; he therefore prefers the title "hydraous oxides." He finds support for this thesis in Van Bemmelen's classical investigations and in more recent work, to which he himself has made contributions.

The first and larger part of the work gives a description of all metallic oxides and of silicic acid, particular attention being paid to the colloidal systems, both sols and gels, which they form. As some of the oxide sols, e.g. ferric oxide and silicic acid, have been to the student of colloids what the guinea pig is to the physiologist, the literature on this aspect of the subject is vast, but it is well presented, and the author

does not merely abstract it, but preserves a critical attitude throughout.

The second part opens a little surprisingly with a chapter on tanning, the inclusion of which, like that of the subsequent chapters on mordants, water purification and soils, is justified by the important part which the hydraous oxides are shown to play in these processes and in determining the properties of soils. The book is handsomely printed and bound, and has been indexed with exceptional care.

(3) As stated in the preface, this volume contains the subject-matter of a number of lectures delivered by Professor Freundlich in America during the summer of 1925. It deals largely with developments so recent that they have not yet been presented systematically in existing text books; some of them, like the differentiation of the two potentials at interfaces, the detailed theory of coagulation velocity and investigations on sols with non-spherical particles being largely the work of the author himself. Other chapters are devoted to the stability of hydrophilic sols and the parts played by hydration and electric factors in determining it, the valency effects in adsorption and coagulation and—this is perhaps the most fascinating one—with "photo-dichroism." This name is given to a phenomenon discovered by Weigert: if a photographic plate is first illuminated till a layer of photochloride is formed, and is then exposed to polarised light, a coloured spot is produced, which, examined by an analyser, shows dichroism and double refraction. The state of polarisation of the reducing light is, so to speak, permanently retained by the reduced silver layer, a very surprising phenomenon, the explanation of which, as the author says, is not easy.

The book will prove a useful summary to readers who manage to keep pace with the literature, and indispensable to those who cannot find time to do so. The author's command of English is remarkable; the only noticeable slip is the use of "vertical" in place of "perpendicular."

(4) This is a translation of the fourth edition of Ostwald's "Praktikum," which has had a considerable success in the original and has already been translated into French. Anyone who carries out the experiments described in it, or even a judiciously chosen half of them, will have a knowledge of the technique of colloid chemistry such as is probably not to be found among graduates in this country.

The translation leaves a good deal to be desired. In some cases, reference to the original is required to make it intelligible: thus Experiment 131 is headed: "Origin of native alumina." The original says: "*Entstehung gewachsener Tonerde*," i.e., formation of sprouted alumina, the well known adsorbent first made by Wislicenus, the like of which certainly does not occur in nature. "*Sprungfiguren*" is given as "Figure formation" instead of "crack formation," etc. For some obscure reason, the translators frequently write "coalesce" instead of "coagulate" and even make the former verb an active one; they also use terms like "molecular" and "molar" as interchangeable, which they are not. Ostwald gives figures calculated from experiments carried out by him personally; this becomes, somewhat surprisingly, a "personally conducted experiment." "Syneresis"—like heretic—is spelt thus in English, and not with an "ae," although the Greek root from which both derive has the diphthong. A good translation is a much more arduous piece of work than most people seem to realise, but the old moral tag about things worth doing at all being worth doing well applies as emphatically to this form of craftsmanship as to more pretentious ones. E. H.

British Industries Fair Luncheon

SIR PHILIP CUNLIFFE-LISTER, President of the Board of Trade, and officials of the Department of Overseas Trade are to be the guests of the joint advisory committee of exhibitors in the British Industries Fair, London and Birmingham, at a luncheon in London on January 19, when they will be thanked for having organised a larger and more representative display than the Fair of 1926. The chairman will be Mr. Walter Lines, representing the London section of exhibitors, and the vice-chairman, Mr. P. R. Martin, of Birmingham.

Dyeing Industry Organisation

Mr. Leach's Bradford Address

INTERESTING comments upon the present tendency in industrial organisation were made on Thursday, December 16, at Bradford, by Mr. W. Leach, of Manchester, in an address before the West Riding Section of the Society of Dyers and Colourists upon "Organisation and the Dyeing Industry."

Reproduction, repetition, specialisation, and standardisation, he said, had become by-words to industrialists, until there seemed to be nothing left outside the category of highly or efficiently organised industry. Apart from the universal conception of organisation, the tendency amongst industrialists was to organise. The massing of interests went on apace, and the accumulation of information could be either useful or disadvantageous—useful if it resulted in the co-operation of all the essential forces, and detrimental if used to crush individual or collective ambition. The dyeing trade did not lend itself altogether to reproduction, repetition, or specialisation, and its organisation was dependent upon its ability to cater for the ever-changing conditions which were largely determined by fashion. If the purchaser of coloured material could be induced to accept certain shades which lent themselves to repetition, thereby eliminating variety, a very efficient organisation could be devised. But what a drab and monotonous world would result, commented Mr. Leach. Such a condition was undesirable.

Importance of Co-operation

One of the first essentials to good organisation was the co-operation of the management and the workpeople, and the organisation must be such that all concerned could adapt themselves to it. The interests of both employers and employees should be the same, each contributing to the prosperity and contentment of the whole community. When joint interests of management and workers could be fostered, and when the two elements co-operated, the result would be good organisation, and the employee would be prepared to give a fair day's work, and the employer a fair day's wage. A worker ceased to exercise his individuality immediately he became part of a combination of workers, and allowed his individual efforts to be subordinated to that of the combined idea of the whole of the employees in the works. The combined idea might be determined by an intelligent conception of industry and society, or by a stupid or disgruntled outlook. In any case, the management had to deal with individuals whose individuality could not be considered. It might be difficult for the worker on his side to understand his relation to the management, and also his attitude towards his fellow workers, and his outlook on general things might be warped by the intermingling of industrial and political events, as no clarified combined idea was ever sufficiently stabilised in the ever-changing conditions of political activities. The objects which managements desired to obtain were that an employee should be capable and efficient, and realise the importance of doing his work in the most efficient manner; and that he should use every effort to avoid waste in power, machinery, and materials. The workers, on the other hand, would probably define their position as a return for such efficiency. Everything possible was being done to prevent unemployment and under-employment, the remuneration being such as to give the fullest opportunity for development, and to be compatible with the profits earned by the employer; with treatment as part of the necessary organisation, and encouragement to contribute to and suggest necessary changes in machinery and processes. If these objects could be kept separate from political bias, and confined to industry to be dealt with, it would be possible to establish the co-operation necessary, and place the industry on a very sound basis. So long as each side was composed of conflicting interests, the idea of combination could only be a weak compromise.

Profit-Sharing and Bonuses

Profit-sharing schemes had been tried, but employers and employees generally were opposed to them; bonus schemes appeared to be very satisfactory where the work was of a reproductive character, and a piece-work system would probably prove most satisfactory in the dyeing industry, because both employer and employee would stand to gain by a reduc-

tion in production costs and higher wages. He deplored as a travesty of minimum wage agreements the system of paying equal wages, and in like manner described as contemptible both the employer who deprived his workpeople of any of the fruits of piece-work intelligently arranged, and the employee who pretended to do an honest day's work, and had no intention of performing one. Mr. Leach said the solution of the organisation in the dyeing trade—and most other industries—lay in the recognition of the mutual interests of all engaged in it. When an employer appreciated and agreed that the proceeds of industry should be fairly distributed, and when the man freely gave of his best, both free from the restrictions of the combined idea, then they would have made the first step towards co-operation. Strife would cease, and honest endeavour become a feature of the future, service before pleasure, and pleasure being appreciated, because it was the result of service.

Adhesives Research Results

Exhibits at the Science Museum

SOME interesting exhibits are on public view at the Science Museum, South Kensington, London, being the results of researches carried out by the Adhesives Research Committee set up by the Department of Scientific and Industrial Research. Sir Herbert Jackson has produced a shellac-creosote composition, and as an example of its power there are shown two small pieces of nickel stuck together with this new substance, which is standing the strain of a straight pull of half a ton. Experiments have proved that it will bear a strain of three tons to the square inch. The new substance is not yet commercially available, but manufacturers interested can obtain the specification. Exhibits arranged by Professor McBain, of Bristol University, show the adhesive power of various substances applied to wood, china, glass, metal, and fabrics. There is an exhibit of work carried out in the production of glue and gelatin from fish, fish skins, and offal. The fishing industry of this country provides a large supply of raw material for the making of glue if better methods for its production can be brought into operation. This appears to have been accomplished through the work of Professor Schryver and Dr. Kernot. A sample of fish glue is shown which is quite free from the objectionable odour of common fish glue, and it has adhesive qualities of a high order. The new fish glue is also a valuable emulsifying agent, and serves for the preparation of stable emulsions of tar. Fish skins are also shown treated in such a fashion that they can be used for the clarification of beers, wines, and other liquids, as a substitute for the very expensive isinglass, which at present has to be imported. Dr. Kernot has been applying himself to the production of isinglass from bladders of fish other than sturgeon, and the new product is said to be of equal value to the isinglass produced from the latter.

Award of Chemical Society Medals

At the ordinary scientific meeting of the Chemical Society held on Thursday, December 16, the president, Professor H. Brereton Baker, F.R.S., announced that the council had unanimously resolved to award the Longstaff Medal for 1927 to Professor Robert Robinson, F.R.S., of Manchester University, for his distinguished researches in organic chemistry. It was also announced that the selection committee for the Edward Frank Harrison Memorial Prize (consisting of the presidents of the Chemical Society, the Institute of Chemistry, the Society of Chemical Industry, and the Pharmaceutical Society) had unanimously resolved that the prize for 1926, of the value of £150, should be awarded to Dr. Charles Robert Harington, of University College, London. Dr. Harington has within the last five years synthesised the active principle of the thyroid gland (thyroxin); he has determined its constitution and worked out a practical process by which it might be produced on a large scale. This artificial product has been found to have the same physiological efficacy as the active principle in the natural extract. The presentation of the Longstaff Medal and of the Harrison Memorial Prize will take place at the annual general meeting of the Chemical Society on March 24, 1927.

Works Measurement of Temperature

Chemical Engineers at Birmingham

MEMBERS of the Chemical Engineering Group of the Society of Chemical Industry held a joint meeting on Friday last at the Birmingham University with the Midland Section of the Society of Chemical Industry, under the presidency of Mr. F. Heron Rogers.

Professor J. W. Hinchley delivered a lecture on "Measurement of Temperature in Technical Practice." He pointed out that this system was quite different from that in laboratory work. Every instrument employed must justify its use by increased profit, either through improvement in production or reduced cost of production, by the elimination of waste, or by reduction of repairs, time taken up on works' operations, or fuel used. On this account a simple device for temperature measurement was usually a more efficient arrangement than a general temperature indicator; and, if it were inexpensive, it would always receive favourable consideration from the "powers that be." In giving a rough outline of the basic principles underlying all temperature work, Professor Hinchley said his object was to encourage chemical engineers to devise their own temperature measuring instruments, especially where economic considerations precluded the use of expensive apparatus. There were two distinct methods of indicating the temperature of a material: (1) by associating with it an indicating substance, which became, from a heat point of view, a part of the material, and indicated by some physical property its own temperature; and (2) by the analysis or measurement of the radiation from its surface. Both methods had their own special utilities and range of accuracy. The first method was that most commonly employed in works practice, while the second was only applicable to solids, liquids, and dense vapours. It was, however, the only method available for measuring the temperature of inaccessible bodies or for extremely high temperatures.

Properties Changing with Temperature

There were various physical changes or properties available for temperature determination by the first method. One of the most important properties was change of length of material; while there were also changes of strength, volume, pressure, colour, electrical resistance, electrical potential, heat content, and physical state. It was their business as chemical engineers, he thought, to bring the Centigrade scale into practical use; the present Fahrenheit system was often a source of trouble. If there were the lb., gallon and degree Centigrade, engineers would be saved a good deal of brain fag. There was no reason, in his view, why they should not use the hydrogen gas thermometer as a practical standard. There could be no critical discussion of measurement of temperature without a consideration of the general principles of heat transmission; one must understand the behaviour of heat before one could attempt to measure it. There was no doubt that radiation took place to a far greater extent than was generally supposed, and that it played an important part in heat conduction in cases where it had been utterly neglected as being of no importance.

In measuring the temperature of gases, probably the greatest errors occurred; and, in regard to it, radiation entered very largely. The thermometer in an ordinary room was supposed to indicate the temperature of the air, but it often indicated radiation from the walls. It was a useful plan to place on the thermometer a silver shield. The temperature of gas was most conveniently taken by fine thermo-couple wires. Thin platinum wire would indicate almost instantaneous changes of temperature. The most important technical instruments might be classified as follows: gas thermometers, liquid thermometers, electrical resistance thermometers, thermo-couples and optical instruments.

Discussion

Mr. J. C. Mann insisted that the subject was of vital interest to the chemical industry. If the old rule-of-thumb methods were to be abolished they must depend upon temperature measurements on a scientific basis. In America, where he had recently spent six weeks, he was struck by the fact that full use was made of these works scientific instruments. At a works in his own particular industry where they were dealing with 50,000 gallons of stuff daily, the whole plant, which was heated by oil fuel, was operated from a small room that

contained numerous pyrometers. He was sure that in this country better use could be made of the appliances they had ready to hand than was made of them at present. Professor Hinchley's observations with regard to radiation were important, and he (Mr. Mann) had found, for example, that better efficiency was obtained after bright copper tubes in an evaporator had sulphided.

Mr. Rhead (chief chemist, Birmingham Gas Department) stated that his staff had constantly to take temperatures at five gasworks, and pyrometers were in general use. In the laboratory the personal factor was possibly a matter of minor importance, but where the work was done on wholesale lines, under difficult and uncomfortable conditions which induced fatigue, the personal factor became most important. Many instrument makers did not seem to realise that a chemist or physicist would not get accurate temperatures unless he was working under comfortable conditions. There was need for more robust instruments for use on the works.

Electroplaters and Depositors

Determining the Acidity of Solutions

At a meeting of the Electroplaters and Depositors Technical Society, held at the Northampton Polytechnic Institute, on Wednesday, December 15, under the chairmanship of Mr. Macnaughtan, Mr. A. W. Hothersall, B.Sc. (Tech.), of the Research Department, Woolwich, read a paper on "The Acidity of Certain Electroplating Solutions." The chairman remarked that the importance of P_H determination was becoming increasingly apparent, and the benefit of its application to the plating shop was now widely appreciated. There was no doubt that future text books on electro-deposition would make a practice of stating the precise P_H of each bath.

Mr. Hothersall said that the plater had always felt the need of some method of estimating P_H , and had roughly satisfied this by attempting to control his bath by using litmus and Congo paper. By this means he had been enabled to keep his nickel solution at a P_H between 4 and 6.4; but with the advance of plating technique and modern requirements, a more refined method of determination was necessary. To do this accurately, it would be necessary to use the quinhydrone electrode, but for the purposes of the plating shop, this expensive apparatus was unnecessary, and sufficiently accurate results could be obtained by indicator methods. The quickest and most simple methods were undoubtedly by means of the comparator and capillator, the former of which could be used to obtain P_H values of coloured solutions, e.g., nickel solutions. These methods were described in detail, and reference also made to the Gillespie Drop Ratio method and the Double Wedge Comparator. The author concluded his paper by appending tables of buffer solutions and indicators, the range of which made them particularly suitable to plating solutions.

During the discussion, various phases of the applications of P_H to shop practice were considered, particularly in connection with the merits of the comparator method as compared with the quinhydrone electrode. The only fact against the introduction of the latter was its cost, while the disadvantage of the former, in addition to its relative inaccuracy, was the fact that the standards were not permanent and would require renewal at frequent intervals. Copies of the paper may be obtained on application to the Secretary, Mr. W. E. Harris, 193, Eversleigh Road, S.W.11. The next meeting will be on January 19, when a paper will be read on "Iron Deposition."

Kamforite

HENSMAN BROS., of Horncastle, the manufacturers of Kamforite, send us a number of recent testimonies to the efficiency of the preparation for soil fumigation and nutriment. It is marketed in qualities specially adapted to ordinary agricultural land, market gardens, private gardens, and greenhouses, and is particularly designed for the extinction of destructive pests. Kamforite was introduced into Holland last year, and the results were so satisfactory that the demand this season reached about 40 tons. This year it has been successfully introduced into Belgium, as well as into Jersey, Canada, Southern Rhodesia, and the Barbadoes. The reports received express satisfaction with the results.

From Week to Week

SIR ALFRED AND LADY MOND have left London for a holiday in the south of France.

MR. DUNCAN MARSH, who has since 1919 been secretary of Brunner, Mond and Co., Ltd., has been appointed to a seat on the board of directors.

MALTOSE may be manufactured from maize in ten hours by a process worked out by the Bureau of Chemistry of the U.S. Department of Agriculture.

MR. E. STEPHENSON has been appointed secretary of the South of Scotland Technical Section of the Papermakers Association of Great Britain and Ireland.

RECENT WILLS INCLUDE: Mr. Joseph Haigh, of Royds Dye Works, Wortley, Leeds, £5,922.—Mr. John Peak, of Fulwood, Preston, chemical manufacturer, £24,243.

THE NEW SUGAR BEET FACTORY for Shropshire is to be erected near Wellington. It is expected that building operations will commence early in January, and that the factory will be completed by the end of July in readiness for next year's crop.

THE DEGREE OF DOCTOR OF SCIENCE of the University of London has been conferred upon Mr. Thomas H. Durrans, head of the Research Department of A. Boake, Roberts and Co., Ltd., for a thesis on "The chlorination of organic compounds."

THE ANNAN GAS CO. has placed an order with the Woodall-Duckham Vertical Retort and Oven Construction Co. (1920), for a T.I.C. Tar Treatment Plant capable of producing tars to the Roads Department Specification, with a capacity of 10 tons per 24 hours.

UNEMPLOYED PERSONS (insured) in chemical manufacture in Great Britain at November 22, 1926, were as follows: Males 9,545, females 1,088, total 10,633. The estimated number of insured persons in Great Britain and Northern Ireland at July, 1926, was: Males 72,680, females 21,850, total 94,530. The percentage of unemployed at November 22 was 11.3.

IN A PAPER before the Royal Society of Arts in London, on Wednesday, December 15, Mr. W. J. U. Woolcock surveyed the dominant features of the chemical industry and its principal fields of activity and promise, and indicated the general trend of manufacturing enterprise. At the conclusion of the discussion, a hearty vote of thanks was accorded Mr. Woolcock for his address.

MR. F. TWYMAN, F.R.S., for many years managing and technical director of Adam Hilger, Ltd., has been awarded the Duddell medal. This medal is awarded by the council of the Physical Society for meritorious work on scientific instruments and materials. In addition to services rendered in the cause of pure science, Mr. Twyman has carried out notable work on a number of technical problems.

APPLICATIONS ARE INVITED for the following appointments: Demonstrator in Chemistry in Guys Hospital Medical School, London, S.E.1. £250. The Dean. December 30.—Lecturers in Organic Chemistry, Physical Chemistry, and Bio-Chemistry in the Indian Institute of Science, Bangalore. Rs. 400-25-500 per month, plus house allowance. The Director. January 31, 1927.—Professor of Organic Chemistry in the Egyptian University, Cairo. £922 10s. to £1,168 1s. Information from the Director, Egyptian Educational Office, 39, Victoria Street, London, S.W.1. December 31.—Adviser in Agricultural Chemistry in the University of Manchester. £400. The Registrar. January 20, 1927.

KEK, LTD., grinding specialists, of Aldwych House, London, W.C.2, report recent orders for Kek grinding and blending mills as follows: No. 1 Kek mill for sugar manufacture (Australia); No. 3 Kek mill for magnesite works (Italy); four No. 1 Kek mills for chemical works (South America); No. 1 Kek mill for soap works (Spain); two No. 4 Kek mills for colour works (Great Britain); two No. 4 Kek mills for maltsters (Great Britain); No. 4 mill for paint works (Great Britain); two No. 4 Kek mills for polish factory; No. 3 Kek mill for colour works (Great Britain); two No. 4 mills for grinding fine chemicals (Great Britain); No. 4 mill for grinding biscuit filling material (Great Britain); No. 4 mill for chemical works (Holland).

GOVERNMENT CONTRACTS made in November include:—ADMIRALTY: distilling plant, P. and B. Evaporators, Ltd., London, S.W.; turpentine, Prices Patent Candle Co., Ltd., London, S.W.—WAR OFFICE: linseed oil, Younghusband, Barnes and Co., Ltd., London, S.E.; zinc, British Metal Corporation, Ltd., London, E.C.—POST OFFICE: Leclanché zinc rods, Locke, Lancaster and W. W. and L. Johnson and Sons, Ltd., London, E.—CROWN AGENTS FOR THE COLONIES: cement, Cement Marketing Co., Ltd., London, S.W., and Beynon and Co., London, E.C.; chemicals, May and Baker, Ltd., London, S.W.; crushing and grinding plant, E. Allan and Co., Ltd., Sheffield; disinfectant, H. E. Hope and Co., Ltd., London, W.; drugs, Howards and Sons, Ltd., Ilford, and British Drug Houses, Ltd., London, E.C.; metal, Phosphor Bronze Co., Ltd., London, S.E.

PROFESSOR H. G. DENHAM, of Canterbury College, Christchurch, N.Z., has been appointed a member of the New Zealand Council of Scientific and Industrial Research.

PROFESSOR A. G. PERKIN's former students in Leeds University have decided to make a presentation to him as an acknowledgment of their indebtedness to his teaching.

PROFESSOR THOMAS TURNER, late of department of metallurgy in the University of Birmingham, has been recommended by the University Council for the title of Emeritus Professor.

THE KAMERLINGH ONNES MEMORIAL LECTURE will be delivered by Professor Ernst Cohen, of Utrecht, at the Institution of Mechanical Engineers, Storey's Gate, London, on Thursday, February 10, 1927, at 8 p.m.

THE HOME SECRETARY has issued a circular drawing the attention of all master painters, master builders, and others employing persons in painting buildings to the requirements of the Lead Paint (Protection against Poisoning) Act, 1926, which comes into force on January 1 next.

AMONG DISEASES OF OCCUPATION in Great Britain and Northern Ireland under the Factory and Workshop Act during November were 1 case of mercurial poisoning, 1 of carbon bisulphide poisoning, and 1 of aniline poisoning. Among fatal industrial accidents were six in chemical works.

MR. J. C. A. BRIERLEY, M.Sc., F.I.C., head of the science department of the Royal Belfast Academical Institution, delivered an address on Wednesday, December 15, in Queen's University, Belfast, to the members of the Belfast section of the Institute of Chemistry Council on "Chemistry as a Factor in Education."

SILLIMANITE, large deposits of which have been found in India, was referred to at the meeting of the Society of Glass Technology on Wednesday, December 15, in London. Professor Turner, of Sheffield University, described the manner in which sillimanite withstands changes in temperature, and Mr. W. J. Rees (also of Sheffield University) said he thought it would prove one of the most valuable refractory materials.

MR. J. J. HEDGES, assistant physicist to the British Research Association for the Woollen and Worsted Industries, has had conferred on him the Doctorate of Philosophy of the University of London. Dr. Hedges submitted a thesis on the moisture content of wool fibres, and it is largely upon this work, which has been carried out in the laboratories of the Research Association at "Torridon," Headingley, Leeds, that the degree has been awarded.

IN THE HOUSE OF COMMONS, on Wednesday, December 15, Mr. Betterton (Parliamentary Secretary to the Minister of Labour), replying to Mr. Kelly, said that the number of persons classified as belonging to the chemical industry and recorded at employment exchanges in Great Britain as unemployed at October 25, 1926, was 11,219, as compared with 9,346 at October 26, 1925, and 8,615 at October 27, 1924. In reply to Mr. H. Williams, he added that he thought that the figures were based on the classification of last July.

INTERNATIONAL COMBUSTION, LTD., of Africa House, Kingsway, inform us that their associated company in America has received orders for the following steam generating equipment during the month of October: Brown Co., Berlin, New Hampshire, complete Lopulco unit system for firing one Heine boiler of 1,000 h.p. complete with air heater and fin furnace; Pressed Steel Car Co., McKees Rock, Pa., complete Lopulco feeding and burning equipment with fin furnaces for two 1,300 h.p. Walsh and Weidner boilers; Phoenix Utility Co., for Houston Light and Power Co., Deepwater Sta., Houston, Tex., one complete Lopulco furnace equipment for one 1,650 h.p. Stirling boiler; Fisher Body Corporation, Detroit, Mich., for Cleveland, Ohio, one complete Lopulco furnace equipment for one 720 h.p. Heine boiler; Ohio River Edison Co., Toronto, Ohio, Stevens and Wood, engineers, two Raymond 15 ton super mills with necessary conveying equipment; General Outdoor Advertising Co., Chicago, Illinois, one Impax mill for one 80 h.p. boiler. The above company has also received further orders which include 59 boilers, 47 stokers, 10 air heaters, and 1 oil still. Information has also come to hand that their Australian Co. has received an order from the Broken Hill Proprietary Co., for complete Lopulco equipment for three Babcock and Wilcox boilers, including the necessary Raymond pulverisers.

Obituary

MR. JOHN WILSON, of Romford, on December 14, aged 78. He was for 40 years manager of Lawes' Chemical Works at Creeksmouth, Barking, retiring some 15 years ago.

MR. ARTHUR OLDROYD, of Dewsbury, on December 19, aged 74. Mr. Oldroyd had been a director since its formation of the Yorkshire Dyeware and Chemical Manufacturing Co., and managing director of its Dewsbury branch. A native of Huddersfield, he was formerly a member of the firm of Howroyd and Oldroyd, dyeware manufacturers, of Dewsbury. He was well known in public life in Dewsbury. He leaves a widow, two daughters, and a son, Mr. Norman Oldroyd, who is connected with the Selby branch of the Yorkshire Dyeware Co.

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Patent Literature

The following information is prepared from published Patent Specifications and from the Illustrated Official Journal (Patents) by permission of the Controller to H.M. Stationery Office. Printed copies of full Patent Specifications accepted may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at 1s. each.

Abstracts of Complete Specifications

261,139. INTERMEDIATES, DYES, AND DYEING. J. E. G. Harris, B. Wylam, J. Thomas, and Scottish Dyes, Ltd., Earl's Road, Grangemouth, Scotland. Application date, May 1, 1925.

Specifications Nos. 247,787 and 251,491 and 260,638 (see THE CHEMICAL AGE, Vol. XIV, pp. 334, 577, and Vol. XV, p. 571) describe the preparation of derivatives of vat dyestuffs which are soluble and can be used for dyeing without the use of vats. It has now been found that these reactions and processes can be applied to a large number of bodies and to quinones generally. Quinones are treated with an alkyl-sulphuric acid halide or chlor-sulphonic acid or oleum in a tertiary base, e.g., pyridine, in the presence of zinc powder to yield a dyestuff or intermediate. In an example, pyridine is treated with methylsulphuric acid chloride, and a mixture of anthraquinone and zinc dust is added. A further quantity of methyl sulphuric acid chloride is added, and the melt heated to 50° C, and then poured into cold water. The residue is extracted and washed with sodium hydroxide solution, and a pale yellow precipitate is obtained by adding salt. This substance dissolves in water, giving a colourless solution with a blue-violet fluorescence. This solution may be boiled with an acid oxidising agent to regenerate anthraquinone of high purity. Other examples are given of the preparation of soluble derivatives of 1:4-diparatolyl-aminoanthraquinone (cyanine green base), 1-methylamido-anthraquinone, 1-hydroxy-4-amido-anthraquinone, 1-chlor-2-carboxylic acid of anthraquinone, 1:5-dichloranthraquinone, 1:4-diamido-anthraquinone, 1:4-dimethyl-diamido-anthraquinone.

261,459. NITRO DERIVATIVES OF AROMATIC AMINES, MANUFACTURE OF. J. W. Leitch and Co., Ltd., and A. E. Everest, Milnsbridge Chemical Works, Huddersfield. Application date, August 13, 1925.

Dinitro compounds of the aromatic series are not usually obtainable without the use of concentrated acids. In this invention, the arylsulpho compounds of paratoluidine, orthotoluidine, parachloraniline, and aniline, are dinitrated, and the arylsulpho group then removed with the formation of the dinitroamines. The dinitration is effected with the use of dilute nitric acid, and the dinitro compounds are produced at temperatures not much above those employed in mono-nitration. It is not necessary to start with an arylsulphamide, but the mononitro derivatives may be converted to the dinitro compounds by treatment with dilute nitric acid at about 100° C. The dinitro compounds thus produced may be treated with concentrated sulphuric acid to split off the arylsulpho group and yield the dinitro derivatives of the corresponding aromatic amines. Examples are given of the treatment of mononitroparatoluene sulpho-paratoluidide and paratoluene-sulpho-orthotoluidide, to obtain dinitro-paratoluidine and dinitro-orthotoluidine.

261,472. CONDENSATION PRODUCTS OF MONO AND DICYCLIC PHENOLS AND ALDEHYDES, MANUFACTURE OF. Chemische Fabriken Dr. K. Albert G.m.b.H., Amöneburg, near Biebrich-on-Rhine, Germany; A. Amann, 12, Aarstrasse, Wiesbaden, Germany, and E. Fonrobert, 66, Adelheidstrasse, Wiesbaden, Germany. Application date, August 19, 1926.

In the production of phenol alcohols by treating phenols with formaldehyde in the presence of alkali, a mixture of mono-, di-, and poly-alcohols is usually obtained and resinous by-products are usually present also. It is now found that condensation products can be obtained without undesirable by-products by combining phenols with the largest possible quantity of the aldehyde which can be bound by the phenol. The addition is gradual, and in such proportions relatively to the excess of aldehyde present that the formation of resinous condensation products is prevented. The phenol is dissolved in a suitable solvent, and the solution added gradually to the whole quantity of the aldehyde. The mixture may be cooled during the reaction. Several examples of these products are given.

261,494. CELLULOSE CONTAINING SOLUTIONS, MANUFACTURE OF. A. Classen, Aachen, Germany. Application date, September 3, 1925. Addition to 236,281.

Specification No. 236,281 (see THE CHEMICAL AGE, Vol. XIV, p. 157) describes the treatment of cellulose-containing substances, e.g., wood, with concentrated hydrochloric acid at 20°-50° C. in the presence of metals or alloys which are not acted upon by hydrochloric acid. In this invention, the metals are replaced wholly or partly by metallic oxides which are not acted upon by hydrochloric acid, e.g., tungsten, vanadium, or molybdenum oxide. The action of the metals or alloys alone can be improved by superficial oxidation. An increased catalytic effect is obtained by the combination of two or more catalysts, especially when one catalyst is present in finely divided condition as a superficial layer on the other catalyst. The catalysts are preferably in the form of very fine wires or threads, such as metal wires from the manufacture of glow lamps. Alternatively, a porous carrier material may be used. Thus silica or porous carbon may be impregnated with ammonium tungstate and heated to incandescence.

261,510. VAT DYESTUFFS OF THE ANTHRAQUINONE SERIES, MANUFACTURE OF. A. G. Bloxam, London. From Chemische Fabrik Griesheim-Electron, Offenbach-on-Main, and Frankfurt-on-Main, Germany. Application date, September 23, 1925.

These dyestuffs are obtained by the interaction of arylketodihydro-*p*-thiazines with aryl-*o*-diamines or their derivatives in which the nitrogen is alkylated or arylated, or their nuclear substitution products. One or both of the two components must be anthraquinone derivatives. The condensation is effected in an organic solvent of high boiling point, with or without a condensing agent such as sodium acetate. Examples are given of the use of anthraquinone dichloroketodihydro-2:1-thiazine and *o*-phenylenediamine; anthraquinone-dichloroketodihydro-2:1-thiazine and 4:5-diamino-1:3 xylene; anthraquinone-dichloroketodihydro-1:2-thiazine and 1:2-diaminoanthraquinone; 1-amino-2-toluidino-anthraquinone and anthraquinone-dichloro-ketodihydro-2:1-thiazine; *p*-tolylketodichlorodihydro-*p*-thiazine and 1:2-diamino-anthraquinone.

261,522. SYNTHETIC RESINS, PRODUCTION OF. Chemische Fabriken Dr. K. Albert G.m.b.H., Amöneburg, near Biebrich-on-Rhine, Germany; A. Amann, 12, Aarstrasse, Wiesbaden, Germany, and E. Fonrobert, 66, Adelheidstrasse, Wiesbaden, Germany. Application date, October 12, 1925.

Synthetic resins are obtained from the intermediate products from phenols and ketones by condensing them with an aldehyde at a temperature not above 80° C., and preferably below 60° C. Sufficient of the alkaline medium is used to dissolve the intermediate products, and the resin is precipitated with an acid. Several examples are given. Reference is directed in pursuance of Section 7, Sub-section 4 of the Patents and Designs Acts of 1907 and 1919, to Specifications Nos. 199,528 and 18,824 of 1912.

261,568. AZO DYESTUFFS, MANUFACTURE OF. W. Carpmal, London. From I. G. Farbenindustrie Akt.-Ges., Leverkusen, near Cologne, Germany. Application date, January 1, 1926.

This invention is for the manufacture of certain dyestuffs by a process described in Specification No. 245,865 (see THE CHEMICAL AGE, Vol. XIV, p. 184a). The dyestuffs are obtained by (1) combining diazotised 4-amino-4'-oxydiphenylsulphone-3'-carboxylic acid with 2-naphthol-8-sulphonic acid; (2) combining diazotised 2-amino-4-sulpho-4'-oxydiphenylsulphone-3'-carboxylic acid with methyl-ketol; (3) combining diazotised 2-amino-4-sulpho-4'-oxydiphenylsulphone-3'-carboxylic acid with *o*-amino-*p*-cresol-ether, again diazotising, and coupling with salicylic acid; (4) coupling diazotised 2-amino-4-sulpho-4'-oxydiphenylsulphone-3'-carboxylic acid with 2-amino-8-naphthol-6-sulphonic acid in an acid medium.

261,559. HYDROCYANIC ACID, PRODUCTION OF. J. Y. Johnson, London. From I. G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. Application date, December 14, 1925.

Formamide is heated as rapidly as possible in the absence of other gases to 400°–900° C. to obtain hydrocyanic acid. The formamide may be sprayed into a heated chamber or vaporised under reduced pressure, and the vapour exposed to high temperature. Dehydrating catalysts may be present such as alumina, bauxite, titanium oxide, thoria, iron oxides, silica gel, aluminium silicate or phosphate, alkali metaborates, silicates, or aluminates. The hydrocyanic acid is rapidly cooled and a good yield is obtained.

261,647. CHROMATES, PROCESS FOR THE MANUFACTURE OF. W. Carpmal, London. From I. G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. Application date, June 25, 1925.

In the working up of chrome iron ore with an alkali carbonate or hydroxide in a mechanical furnace, chalk or dolomite is usually added to render the melt more permeable. In this invention a mixture of ferric oxide and magnesia is employed in place of the chalk or dolomite. The hot mixture is quenched in hot water, and the alkali aluminate dissolved out. The residue contains undecomposed chrome ore and magnesium and iron oxides, and may be employed again as the added material. The content of the magnesium oxide in the added material may vary from 20 to 50 per cent. and may be maintained by the addition of either magnesia or ferric oxide.

NOTE.—Abstracts of the following specifications which are now accepted, appeared in THE CHEMICAL AGE when they became open to inspection under the International Convention:—238,574 (Farbwerke vorm. Meister, Lucius, & Brüning), relating to derivatives of benzantrones, see Vol. XIII, p. 427; 240,801 (Grasselli Chemical Co.), relating to manufacture of sulphur dioxide and sulphuric acid, see Vol. XIII, p. 581; 242,635 (Montecatini Soc. Generali per l'Industria Mineraria et Agricola), relating to electrolytic production of hydrogen and oxygen, see Vol. XIV, p. 59; 243,356 (E. L. Rinman), relating to pure aluminium hydrate, see Vol. XIV, p. 113; 249,555 (M. Praetorius and K. Wolf), relating to moulded silicic acid gel, see Vol. XIII, p. 551; 251,942 (Salzwerke Heilbron Akt.-Ges., T. Lichtenberger, and K. Flor), relating to obtaining sulphur from alkaline earth sulphates, see Vol. XV, p. 88; 252,152 (F. Fischer and H. Tropech), relating to production of carbon, see Vol. XV, p. 117.

International Specifications not yet Accepted

259,930. OXIDISING ORGANIC COMPOUNDS. Silesia Verein Chemischer Fabriken, Ida- und Marienhütte, near Saarau, Germany. International Convention date, October 19, 1925.

Organic compounds are oxidised by means of solutions of polythionic acids or their salts. Thus, the reaction product from methylaniline and carbon disulphide and a base is oxidised by polythionate solution to obtain dimethyl-diphenyl-thiouram disulphide. Dimethyl-dithiocarbamic acid can be oxidised to tetramethyl-thiouram disulphide by sodium tetrathionate.

259,933. VULCANISATION ACCELERATORS. Naugatuck Chemical Co., Elm Street, Naugatuck, Conn., U.S.A. (Assignees of S. M. Cadwell, 15, Brook Terrace, Leonia, N.J., U.S.A., and A. T. Maximoff, 356, West 145th Street, New York.) International Convention date, October 15, 1925.

Vulcanisation accelerators are made by condensing an aldehyde with a basic nitrogenous material at 135° to 145° C., an acid being added if the nitrogenous material is strongly basic. Thus, two molecular parts of heptaldehyde and one molecular part of aniline are heated to 140° C. in a closed vessel, the pressure developed being maintained for 30 minutes. The product is heated to 135° to 145° C. for twenty hours, or the impurities removed by steam distillation. Other accelerators are obtained from heptaldehyde and ammonia, acetaldehyde and aniline, butyraldehyde and aniline, aldol and aniline, nonaldehyde and aniline, and heptaldehyde and ethylamine, *p*-toluidine, benzidine, *p*-phenylenediamine, *p*-amino-dimethyl-aniline, and urea. The accelerator may be used in the proportion of 0.1 per cent.

259,950. UREA-FORMALDEHYDE CONDENSATION PRODUCTS. I. G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. International Convention date, October 16, 1925. The condensation product from urea and formaldehyde in

the presence of mono- and di-sodium phosphates is hardened by exposure to gaseous sulphur dioxide, or a solution of sulphur dioxide in acetone. Condensation products in the form of films, fibres, or moulded articles may be thus treated.

259,953. GLASS AND BARIUM SILICATE. Rhenania-Kunheim Verein Chemischer Fabriken Akt.-Ges., Berlin. International Convention date, October 16, 1925.

Barium silicate for use in glass-making is obtained by heating a mixture of heavy spar 100 parts, and quartz sand 13 parts, to 1,200° C. in a revolving furnace with introduction of steam. The product is free from sulphuric acid, has a high barium oxide content, and is easily sintered.

259,960-1. PYRIDINE DERIVATIVES. Deutsche Gold- und Silber-Scheideanstalt vorm. Roessler, 7, Weissfrauenstrasse, Frankfurt-on-Main, Germany. International Convention date, October 17, 1925.

259,960. Pyridine compounds containing iodine in the 3- or 5-position are treated with chlorine, and the products can be treated with alkali to obtain iodosopyridines, and these by heating to obtain iodoxy-pyridines. Examples are given of the production of pyridine-3-iodochloride, 2-chloropyridine-5-iodochloride, 2-chloro-5-iodosopyridine and 2-chloro-5-iodoxy-pyridine. These compounds have bactericidal properties.

259,961. β -aminopyridine and its derivatives are diazotised and treated with a reducing agent such as stannous chloride to obtain β -pyridylhydrazine and its derivatives.

259,970. DYES AND DYEING. I. G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. (Assignees of Farbenfabriken vorm. F. Bayer und Co., Leverkusen, near Cologne, Germany.) International Convention date, October 14, 1925.

Trisazo dyes which give direct dyeings in green shades which can be diazotised on the fibre and developed with β -naphthol or methylphenyl-pyrazolone are obtained by coupling an aminazo compound, obtained from a *p*-nitramine or acetyl-*p*-diamine or a derivative and a diazotisable second component with a derivative of an aminonaphthol sulphonic acid containing a free amino group, further diazotising the resulting dyestuffs and coupling with methylketol or methylphenyl-pyrazolone or a derivative, and finally splitting off the acetyl group or reducing the nitro group of the starting component. The preparation of a number of dyestuffs is described, of which that from the following components is typical: 4-acetylaminonaphthol-2-sulphonic acid \rightarrow 1: 2-aminonaphthol-ethyl-ether-6-sulphonic acid \rightarrow *p*-aminobenzoyl-2-amino-5- (or 8-) naphthol-7- (or 6-) sulphonic acid \rightarrow methylphenyl-pyrazolone or methylketol.

259,973. ISONAPHTHYRIDINE COMPOUNDS. Deutsche Gold- und Silber-Scheideanstalt vorm. Roessler, 7, Weissfrauenstrasse, Frankfurt-on-Main, Germany. International Convention date, October 17, 1925.

3-aminopyridine and its derivatives are treated by known methods for the synthesis of quinoline to obtain isonaphthridine and its derivatives. In an example, α -chloro- β -1-aminopyridine is heated with glycerin in the presence of sulphuric acid and arsenic acid, or other oxidising agent, such as nitrobenzene. The products have therapeutic properties.

259,977. IODOPYRIDINE. A. Binz and C. R  th, 42, Invalidenstrasse, Berlin. (Assignees of Deutsche Gold- und Silber-Scheideanstalt vorm. Roessler, 7, Weissfrauenstrasse, Frankfurt-on-Main, Germany.) International Convention date, October 17, 1925. Addition to 251,578.

3-nitropyridine is reduced with iron and acid to 3-aminopyridine, which is then diazotised and treated with alkali iodide to obtain 3-iodopyridine.

259,982. PYRIDINE COMPOUNDS. Deutsche Gold- und Silber-Scheideanstalt vorm. Roessler, 7, Weissfrauenstrasse, Frankfurt-on-Main, Germany. International Convention date, October 17, 1925.

These compounds are obtained by condensing 3-hydrazinopyridine or derivatives of 2- or 3-hydrazinopyridine with aliphatic, aromatic, or aliphatic-aromatic aldehydes or ketones, optionally with a solvent and condensing agent. In an example, diazotised β -aminopyridine is reduced with stannous chloride, and the 3-pyridylhydrazine obtained is treated with benzaldehyde. By the use of temperatures above 100° C., the con-

densation can be carried further, and the condensation products can be heated with agents capable of splitting off ammonia.

259,999. DYE PREPARATIONS. I. G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. (Assignees of Farbwerke vorm. Meister, Lucius, und Brüning, Höchst-on-Main, Germany.) International Convention date, October 17, 1925.

Dry dyestuffs are mixed with a dry alkali starch preparation obtained by mixing alkali with starch and drying in vacuo, with or without the addition of a wetting or dispersing agent and a hydrosulphite.

260,000. ANTHRACENE DERIVATIVES. I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. (Assignees of Farbwerke vorm. Meister, Lucius, und Brüning, Höchst-on-Main, Germany). International Convention date, October 17, 1925.

Anthracene derivatives are obtained by subliming the corresponding anthraquinone derivative, mixed with copper or zinc dust, into a stream of hydrogen passed through a tube containing copper with or without zinc. 2-aminoanthracene is obtained from 2-aminoanthraquinone, α -anthramine from 1-aminoanthraquinone, 2-methylanthramine from 2-methylanthraquinone, 1-diethylanthramine from 1-diethylamino-anthraquinone, 2:6-dimethoxy-anthracene from anthraflavinic acid dimethyl-ether, 2-methylanthracene from 2-methylanthraquinone and benzanthrene from benzanthrone.

260,001. INDIARUBBER. Soc. Italiana Pirelli, Milan, Italy. International Convention date, October 17, 1925.

To prevent the ageing of indiarubber, the evaporation residue of the latex serum is added to it after the removal of quebrachitol and proteins.

260,212. BASIC COPPER SULPHATE. J. P. Bemberg Akt.-Ges., 100, Berlinerstrasse, Rittershausen, Barmen, Germany. International Convention date, October 20, 1925.

Basic copper sulphate of constant composition, suitable for preparing ammoniacal copper solutions for dissolving cellulose, is obtained by adding sulphuric acid to an ammoniacal copper sulphate solution and washing the precipitate. Cellulose solutions prepared with this compound avoid irregularities in the spinning of artificial silk.

Specifications Accepted with Date of Application

234,853. Manufacture of metals or alloys in a revolving furnace. Process of. L. P. Basset. June 2, 1924.

246,156. Thioindoxyl derivative, Manufacture of. Soc. of Chemical Industry in Basle. January 14, 1925.

246,827. Separating aluminium nitrate from potassium, sodium, iron, calcium, magnesium nitrates, present in mixed solutions of these salts, Method of. S.I.P. Soc. Italiana Potassa. January 28, 1925.

251,229. Phosphoric esters of carbohydrates and polyvalent alcohols, Process of manufacture of. Soc. Chimique des Usines du Rhône. April 27, 1925.

253,085. Electrical deposition of organic materials. Kodak, Ltd. June 8, 1925.

255,466. Diacylisoithiurea S-alkylethers, Process for the manufacture of. Chemische Fabrik auf Actien vorm. E. Schering. July 16, 1925.

256,950. Gallium, indium, and similar metals and alloys. Purification of. British Thomson-Houston Co. August 12, 1925.

258,828. Sulphur from alkaline earth sulphates, Process for obtaining. Salzwirk Heilbronn Akt.-Ges., T. Lichtenberger, and K. Flor. February 9, 1926. Addition to 251,942.

261,919, 261,927 and 261,975. Distillation or heat treatment of carbonaceous and other materials, Apparatus for. F. D. Marshall. June 5, 1925.

262,157. Products containing cellulose, Manufacture of. C. Dreyfus. June 6, 1925.

262,179. Rubber, Process for the production of. H. Beckmann. September 2, 1925. Addition to 240,430.

262,206. Alloy irons and steels and the production thereof. W. B. Hamilton and T. A. Evans. September 24, 1925.

262,243. Azo dyestuffs, British Dyestuffs Corporation, Ltd., M. Mendoza, and K. H. Saunders. November 13, 1925.

262,278. Active carbon in a pulverulent form at low temperatures, Process of producing. K. Bube. December 22, 1925.

262,301. Complex antimony compounds, Manufacture of. W. Carpmael. (I.G. Farbenindustrie Akt.-Ges.) February 15, 1926.

262,302. Carbonising coal and cracking oil. Combined process for. W. E. Trent. February 15, 1926.

262,306. Silicic acid gels, Manufacture of. W. Carpmael. (I.G. Farbenindustrie Akt.-Ges.) February 19, 1926.

262,320. Ammonium sulphate, Process of producing. Soc. Anon. des Fours a Coke Somet-Solvay et Piette. March 22, 1926.

Prohibition of Preservatives in Food

Date of Operation of Order

MR. NEVILLE CHAMBERLAIN has decided that there can be no further postponement of the regulations prohibiting the use of certain preservatives in food, and, with some exceptions mentioned below, they will come into operation, as arranged, on January 1, 1927. On Saturday, December 18, the Ministry issued a circular to Sale of Food and Drugs Acts authorities, port and certain other sanitary authorities in England and Wales, enclosing a copy of the Public Health (Preservatives in Food) Amendment Regulations, 1926, which postpone the operation of the Order of last year, so far as certain foods are concerned, and make some minor alterations in the regulations. The dates on which the principal regulations, as now amended, will come into operation are as follows: January 1, 1927: All foods except those specified below.—July 1, 1927: Bacon, ham, egg yolk, and articles of food containing preservative necessarily introduced by the use in their preparation of preserved margarine.—January 1, 1928: Butter, cream, and articles of food containing preservative necessarily introduced by the use in their preparation of preserved bacon, preserved ham, preserved egg yolk, or preserved cream.—July 1, 1928: Articles of food containing preservative necessarily introduced by the use in their preparation of preserved butter. It is stated in the circular that arrangements with the Commissioners of Customs and Excise have now been so modified as to provide that it will normally be left to local authorities to enforce the regulations as regards imports of fresh fruit (not including pulp), in addition to meat and fish, and their products.

Oil and Chemical Importer's Bankruptcy

THE first meeting of the creditors of Henry Albert Gibbs, 9, John Street, Lozells, Birmingham, oil and chemical importer and refiner, was held on Monday in Birmingham. The statement of affairs showed ranking liabilities of £290 17s. 7d., and there were no assets. Debtor attributed his failure to liabilities in respect of guarantee, given on behalf of a limited company. It appeared that in May, 1922, debtor promoted an oil and chemical refining company with a nominal capital of £1,500. He stated that he was allotted £400 shares for services rendered, and was appointed managing director. He said that in February, 1925, a fire occurred at the company's premises, when the whole of the stock and most of the machinery and effects were destroyed. The company was not insured and a loss of about £500 had been sustained. Recently debtor had been sued under guarantees he had given for moneys found for the company and two judgments had been obtained against him amounting to £170. One of those judgments had been followed by the petition on which the receiving order had been made. The matter was left with the Official Receiver as trustee of the estate.

Pilchard Oil from Canada

THE steamer *M.S. Dinteldyk* recently left Vancouver with a cargo of 625 tons of pilchard oil destined for Europe and thus inaugurated the shipping of a new British Columbia product to European markets. Converting fish into oil and meal has become an important industry on the west coast of Vancouver Island, British Columbia. This year fifteen plants are operating, ten more than last year. Two million dollars have been invested in the business and during the last few months \$700,000 have been invested for new machinery for the older plants. The aggregate capacity of these plants is more than six times as great as last season, which was the first year of the industry. The first run of the pilchards commenced in June and lasted until about the end of October. If the run of these fish comes up to expectations, the value of the year's production should be in the neighbourhood of \$2,000,000.

Weekly Prices of British Chemical Products

The prices and comments given below respecting British chemical products are based on direct information supplied by the British manufacturers concerned. Unless otherwise qualified, the figures quoted apply to fair quantities, net and naked at makers' works.

General Heavy Chemicals

ACID ACETIC, 40% TECH.—£19 per ton.
 ACID BORIC, COMMERCIAL.—Crystal, £34 per ton; powder, £36 per ton.
 ACID HYDROCHLORIC.—3s. 9d. to 6s. per carboy d/d, according to purity, strength, and locality.
 ACID NITRIC, 80° Tw.—£21 10s. to £27 per ton, makers' works, according to district and quality.
 ACID SULPHURIC.—Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations: 140° Tw., Crude Acid, 60s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., Non-arsenical, £6 15s. per ton.
 AMMONIA ALKALI.—£6 15s. per ton f.o.r. Special terms for contracts.
 BISULPHITE OF LIME.—£7 10s. per ton, packages extra, returnable.
 BLEACHING POWDER.—Spot, £9 10s. per ton d/d; Contract, £8 10s. per ton d/d, 4-ton lots.
 BORAX, COMMERCIAL.—Crystals, £19 10s. to £20 per ton; granulated, £19 per ton; powder, £21 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain.)
 CALCIUM CHLORIDE (SOLID).—£5 12s. 6d. to £5 17s. 6d. per ton d/d carr. paid.
 COPPER SULPHATE.—£25 10s. per ton.
 METHYLATED SPIRIT 61 O.P.—Industrial, 2s. 5d. to 2s. 10d. per gall.; pyridinised industrial, 2s. 7d. to 3s. per gall.; mineralised, 3s. 6d. to 3s. 10d. per gall.; 64 O.P., 1d. extra in all cases; prices according to quantity.
 NICKEL SULPHATE.—£38 per ton d/d.
 NICKEL AMMONIA SULPHATE.—£38 per ton d/d.
 POTASH CAUSTIC.—£30 to £33 per ton.
 POTASSIUM BICHROMATE.—4½d. per lb.
 POTASSIUM CHLORATE.—3½d. per lb., ex wharf, London, in cwt. kegs.
 SALAMMONIAC.—£45 to £50 per ton d/d. Chloride of ammonia, £37 to £45 per ton, carr. paid.
 SALT CAKE.—£3 15s. to £4 per ton d/d. In bulk.
 SODA CAUSTIC, SOLID.—Spot lots delivered, £15 2s. 6d. to £18 per ton, according to strength; 20s. less for contracts.
 SODA CRYSTALS.—£5 to £5 5s. per ton ex railway depots or ports.
 SODIUM ACETATE 97/98%.—£21 per ton.
 SODIUM BICARBONATE.—£10 10s. per ton, carr. paid.
 SODIUM BICHROMATE.—3½d. per lb.
 SODIUM BISULPHITE POWDER, 60/62%.—£17 per ton for home market, 1-cwt. iron drums included.
 SODIUM CHLORATE.—2½d. per lb.
 SODIUM NITRITE, 100% BASIS.—£27 per ton d/d.
 SODIUM PHOSPHATE.—£14 per ton, f.o.r. London, casks free.
 SODIUM SULPHATE (GLAUBER SALTS).—£3 12s. 6d. per ton.
 SODIUM SULPHIDE CONC. SOLID, 60/65.—£13 5s. per ton d/d. Contract, £13. Carr. paid.
 SODIUM SULPHIDE CRYSTALS.—Spot, £8 12s. 6d. per ton d/d. Contract, £8 10s. Carr. paid.
 SODIUM SULPHITE, PEA CRYSTALS.—£14 per ton f.o.r. London, 1-cwt. kegs included.

Coal Tar Products

ACID CARBOLIC CRYSTALS.—6½d. to 7d. per lb. Crude 60's, 1s. 8d. to 1s. 10½d. per gall.
 ACID CRESYLIC 99/100.—2s. 6d. per gall. Steady. 97/99.—2s. to 2s. 6d. per gall. Pale, 95%, 1s. 10d. to 2s. 6d. per gall. Dark, 1s. 9d. to 2s. 3d. per gall.
 ANTHRACENE.—A quality, 2½d. to 3d. per unit. 40%, 3d. per unit.
 ANTHRACENE OIL, STRAINED.—8d. to 8½d. per gall. Unstrained, 7½d. to 8d. per gall.; both according to gravity.
 BENZOL.—Crude 65's, 1s. 4d. to 1s. 5d. per gall., ex works in tank wagons. Standard Motor, 2s. to 2s. 3d. per gall., ex works in tank wagons. Pure, 2s. 3d. to 2s. 6d. per gall., ex works in tank wagons. Steady.
 TOLUOL.—90%, 2s. to 3s. per gall. Firm. Pure, 2s. 3d. to 3s. 3d. per gall.
 XYLOL.—2s. 3d. to 3s. per gall. Pure, 4s. per gall.
 CREOSOTE.—Cresylic, 20/24%, 10½d. per gall. Standard specification, 6½d. to 9d.; middle oil, 7½d. to 8d. per gall. Heavy, 8½d. to 9½d. per gall. Firm.
 NAPHTHA.—Crude, 10d. to 1s. 1d. per gall. according to quality. Solvent 90/160, 2s. to 2s. 1d. per gall. Solvent 95/160, about 2s. per gall. Solvent 90/190, 1s. 3½d. to 1s. 4d. per gall.
 NAPHTHALENE CRUDE.—Drained Creosote Salts, £8 per ton. Whizzed or hot pressed, £9 per ton.
 NAPHTHALENE.—Crystals, £11 10s. to £12 10s. per ton. Quiet, Flaked, £12 10s. to £13 per ton, according to districts.
 PITCH.—Medium soft, 122s. 6d. to 190s. per ton, according to district. Prices nominal.
 PYRIDINE.—90/140, 12s. 6d. to 17s. per gall. Nominal. 90/180, 8s. 6d. to 9s. per gall. Heavy, 7s. to 10s. per gall.

Intermediates and Dyes

In the following list of Intermediates delivered prices include packages except where otherwise stated:

ACID AMIDONAPHTHOL DISULPHO (1-8-2-4).—10s. 9d. per lb.
 ACID ANTHRANILIC.—6s. 6d. per lb. 100%.
 ACID BENZOIC.—1s. 9d. per lb.
 ACID GAMMA.—8s. per lb.
 ACID H.—3s. 3d. per lb. 100% basis d/d.
 ACID NAPHTHIONIC.—2s. 2d. per lb. 100% basis d/d.
 ACID NEVILLE AND WINTHER.—4s. 9d. per lb. 100% basis d/d.
 ACID SULPHANILIC.—9d. per lb. 100% basis d/d.
 ANILINE OIL.—9½d. per lb. naked at works.
 ANILINE SALTS.—9½d. per lb. naked at works.
 BENZALDEHYDE.—2s. 1d. per lb.
 BENZIDINE BASE.—3s. 3d. per lb. 100% basis d/d.
 BENZOIC ACID.—1s. 8½d. per lb.
 o-CRESOL 29/31° C.—4d. to 4½d. per lb. Quiet.
 m-CRESOL 98/100%.—2s. 3d. per lb. Fair inquiry.
 p-CRESOL 32/34° C.—2s. 3d. per lb. Fair inquiry.
 DICHLORANILINE.—2s. 3d. per lb.
 DIMETHYLANILINE.—2s. per lb. d/d. Drums extra.
 DINITROBENZENE.—9d. per lb. naked at works.
 DINITROCHLOROBENZENE.—£84 per ton d/d.
 DINITROTOLUENE.—48/50° C. 8d. per lb. naked at works. 66/68° C. 9d. per lb. naked at works.
 DIPHENYLAMINE.—2s. 10d. per lb. d/d.
 a-NAPHTHOL.—2s. per lb. d/d.
 B-NAPHTHOL.—11d. to 1s. per lb. d/d.
 a-NAPHTHYLAMINE.—1s. 3d. per lb. d/d.
 B-NAPHTHYLAMINE.—3s. per lb. d/d.
 o-NITRANILINE.—5s. 9d. per lb.
 m-NITRANILINE.—3s. per lb. d/d.
 p-NITRANILINE.—1s. 9d. per lb. d/d.
 NITROBENZENE.—7d. per lb. naked at works.
 NITRONAPHTHALENE.—9d. per lb. d/d.
 R. SALT.—2s. 4d. per lb. 100% basis d/d.
 SODIUM NAPHTHIONATE.—1s. 8½d. per lb. 100% basis d/d.
 o-TOLUIDINE.—9d. per lb. naked at works.
 p-TOLUIDINE.—2s. 2d. per lb. naked at works.
 m-XYLIDINE ACETATE.—2s. 11d. per lb. 100%.

Wood Distillation Products

ACETATE OF LIME.—Brown, £9 10s. to £10 per ton. Scarce. Grey, £17 10s. per ton. Liquor, 9d. per gall. 32° Tw.
 CHARCOAL.—£9 to £10 per ton and upwards, according to grade and locality. Very scarce and in better demand.
 IRON LIQUOR.—1s. 6d. per gall. 32° Tw. 1s. 2d. per gall. 24° Tw.
 RED LIQUOR.—9½d. to 1s. per gall.
 WOOD CREOSOTE.—2s. 9d. per gall. Unrefined.
 WOOD NAPHTHA, MISCIBLE.—3s. 10d. to 4s. per gall., 60% O.P. Solvent, 4s. 2d. to 4s. 3d. per gall, 40% O.P. Both scarce and in good demand.
 WOOD TAR.—£3 to £5 per ton and upwards, according to grade.
 BROWN SUGAR OF LEAD.—£41 10s. to £42 per ton.

Rubber Chemicals

ANTIMONY SULPHIDE.—Golden, 6d. to 1s. 5½d. per lb., according to quality, Crimson, 1s. 3d. to 1s. 7½d. per lb., according to quality.
 ARSENIC SULPHIDE, YELLOW.—2s. per lb.
 BARYTES.—£3 10s. to £6 15s. per ton, according to quality.
 CADMIUM SULPHIDE.—2s. 9d. per lb.
 CARBON BISULPHIDE.—£20 to £25 per ton, according to quantity.
 CARBON BLACK.—5½d. per lb., ex wharf.
 CARBON TETRACHLORIDE.—£46 to £55 per ton, according to quantity, drums extra.
 CHROMIUM OXIDE, GREEN.—1s. 2d. per lb.
 DIPHENYLGUANIDINE.—3s. 9d. per lb.
 INDIARUBBER SUBSTITUTES, WHITE AND DARK.—5½d. to 6½d. per lb.
 LAMP BLACK.—£35 per ton, barrels free.
 LEAD HYPOSULPHITE.—9d. per lb.
 LITHOPONE, 30%.—£22 10s. per ton.
 MINERAL RUBBER "RUBPRON".—£13 12s. 6d. per ton f.o.r. London.
 SULPHUR.—£9 to £11 per ton, according to quality.
 SULPHUR CHLORIDE.—4d. per lb., carboys extra.
 SULPHUR PRECIP. B.P.—£47 10s. to £50 per ton.
 THIOCARBAMIDE.—2s. 6d. to 2s. 9d. per lb. carriage paid.
 THIOCARBANILIDE.—2s. 1d. to 2s. 3d. per lb.
 VERMILION, PALE OR DEEP.—5s. 3d. per lb.
 ZINC SULPHIDE.—1s. 1d. per lb.

Pharmaceutical and Photographic Chemicals

ACID, ACETIC, PURE, 80%.—£39 per ton ex wharf London in glass containers.

ACID, ACETYL SALICYLIC.—2s. 5d. to 2s. 6d. per lb. Firm.

ACID, BENZOIC B.P.—2s. to 2s. 3d. per lb., according to quantity.

ACID, BORIC B.P.—Crystal, £40 to £43 per ton; powder, £44 to £49 per ton. Carriage paid any station in Great Britain, in ton lots.

ACID, CAMPHORIC.—19s. to 21s. per lb.

ACID, CITRIC.—1s. 3½d. to 1s. 4½d. per lb., less 5%.

ACID, GALLIC.—2s. 8d. per lb. for pure crystal, in cwt. lots.

ACID, PYROGALLIC, CRYSTALS.—7s. 3d. per lb. Resublimed, 8s. 3d. per lb.

ACID, SALICYLIC, B.P.—1s. 4d. to 1s. 6d. per lb. Firm and good inquiry. Technical.—1s. to 1s. 0½d. per lb.

ACID, TANNIC B.P.—2s. 9d. to 2s. 11d. per lb.

ACID, TARTARIC.—1s. 0½d. per lb., less 5%.

AMIDOL.—9s. 6d. per lb., d/d.

ACETANILIDE.—1s. 7d. to 1s. 8d. per lb. for quantities.

AMIDOPYRIN.—11s. 6d. per lb.

AMMONIUM BENZOATE.—3s. 3d. to 3s. 6d. per lb., according to quantity.

AMMONIUM CARBONATE B.P.—£37 per ton. Powder, £39 per ton in 5 cwt. casks. Resublimed: lump, 1s. per lb.; powder, 1s. 3d. per lb.

ASPIRIN.—2s. 4d. to 2s. 5d. per lb. Good demand.

ATROPINE SULPHATE.—11s. per oz. for English make.

BARBITONE.—8s. 9d. per lb.

BENZONAPHTHOL.—3s. 3d. per lb. spot.

BISMUTH CARBONATE.—12s. 3d. to 12s. 3d. per lb.

BISMUTH CITRATE.—9s. 3d. to 11s. 3d. per lb.

BISMUTH SALICYLATE.—10s. to 12s. per lb.

BISMUTH SUBNITRATE.—10s. 6d. to 12s. 6d. per lb., all above bismuth salts, according to quantity.

BISMUTH NITRATE.—6s. 9d. per lb.

BISMUTH OXIDE.—13s. 9d. per lb.

BISMUTH SUBCHLORIDE.—11s. 9d. per lb.

BISMUTH SUBGALLATE.—9s. 9d. per lb.

BORAX B.P.—Crystal, £24 per ton; powder, £25 per ton. Carriage paid any station in Great Britain, in ton lots.

BROMIDES.—Potassium, 1s. 9d. to 1s. 10d. per lb.; sodium, 2s. to 2s. 2d. per lb.; ammonium, 2s. 3d. to 2s. 4d. per lb., all spot.

CALCIUM LACTATE.—1s. 5d. to 1s. 6d.

CHLORAL HYDRATE.—3s. 3d. to 3s. 6d. per lb., duty paid.

CHLOROFORM.—2s. 3d. to 2s. 7½d. per lb., according to quantity.

CREOSOTE CARBONATE.—6s. per lb.

FORMALDEHYDE.—£39 per ton, in barrels ex wharf.

GUAIACOL CARBONATE.—6s. 6d. to 7s. per lb.

HEXAMINE.—2s. 4d. to 2s. 6d. per lb.

HOMATROPINE HYDROBROMIDE.—30s. per oz.

HYDRASTINE HYDROCHLORIDE.—English make offered at 120s. per oz.

HYDROGEN PEROXIDE (12 VOLS.).—1s. 8d. per gallon f.o.r. makers' works, naked.

HYDROQUINONE.—4s. per lb., in cwt. lots.

HYPOPHOSPHITES.—Calcium, 3s. 6d. per lb., for 28-lb. lots; potassium, 4s. 1d. per lb.; sodium, 4s. 9d. per lb.

IRON AMMONIUM CITRATE B.P.—2s. 1d. to 2s. 4d. per lb. Green, 2s. 4d. to 2s. 9d. per lb. U.S.P., 2s. 2d. to 2s. 5d. per lb.

IRON PERCHLORIDE.—22s. per cwt., 112 lb. lots.

MAGNESIUM CARBONATE.—Light Commercial, £33 per ton net.

MAGNESIUM OXIDE.—Light Commercial, £67 10s. per ton, less 2½%; Heavy Commercial, £22 per ton, less 2½%; Heavy Pure, 2s. to 2s. 3d. per lb., according to quantity.

MENTHOL.—A.B.R. recrystallised B.P., 18s. 9d. per lb. net; Synthetic, 11s. to 12s. per lb., according to quantity; Liquid (95%), 12s. per lb.; Detached Cryst., 15s. per lb.

MERCURIALS.—Red Oxide, 6s. 5d. to 6s. 7d. per lb., levig., 5s. 11d. to 6s. 1d. per lb.; Corrosive Sublimate, Lump, 4s. 8d. to 4s. 10d. per lb., Powder, 4s. 1d. to 4s. 3d. per lb.; White Precipitate, 4s. 10d. to 5s. per lb., Powder, 4s. 11d. to 5s. 1d. per lb., Extra Fine, 5s. 1d. to 5s. 2d. per lb.; Calomel, 5s. 3d. to 5s. 5d. per lb.; Yellow Oxide, 5s. 10d. to 5s. 11d. per lb.; Persulph, B.P.C., 5s. 1d. to 5s. 2d. per lb.; Sulph. nig., 4s. 10d. to 4s. 11d. per lb.

METHYL SALICYLATE.—1s. 9d. per lb.

METHYL SULPHONAL.—15s. 6d. per lb.

METCL.—11s. per lb. British make.

PARA-FORMALDEHYDE.—1s. 9d. per lb. for 100% powder.

PARALDEHYDE.—1s. 4d. per lb.

PHENACETIN.—3s. 9d. to 4s. per lb.

PHENAZONE.—5s. 9d. to 6s. per lb.

PHENOLPHTHALEIN.—6s. to 6s. 3d. per lb.

POTASSIUM BITARTRATE 99/100% (Cream of Tartar).—81s. per cwt., less 2½% for ton lots.

POTASSIUM CITRATE.—1s. 11d. to 2s. 2d. per lb.

POTASSIUM FERRICYANIDE.—1s. 9d. per lb., in cwt. lots.

POTASSIUM IODIDE.—16s. 8d. to 17s. 2d. per lb., according to quantity.

POTASSIUM METABISULPHITE.—6d. per lb., 1-cwt. kegs included, f.o.r. London.

POTASSIUM PERMANGANATE.—B.P. crystals, 6½d. per lb., spot. QUININE SULPHATE.—2s. per oz., 1s. 8d. to 1s. 9d. per oz. in 100 oz. tins.

RESORCIN.—4s. to 4s. 3d. per lb., spot.

SACCHARIN.—55s. per lb. Quiet.

SALOL.—3s. to 3s. 3d. per lb.

SODIUM BENZOATE, B.P.—1s. 10d. to 2s. 2d. per lb.

SODIUM CITRATE, B.P.C., 1911.—1s. 8d. to 1s. 11d. per lb. B.P.C., 1923.—2s. 1d. to 2s. 2d. per lb. U.S.P., 1s. 11d. to 2s. 2d. per lb., according to quantity.

SODIUM FERROCYANIDE.—4d. per lb. carriage paid.

SODIUM HYPOSULPHITE, PHOTOGRAPHIC.—£15 5s. per ton, d/d consignee's station in 1-cwt. kegs.

SODIUM NITROPRUSSIDE.—16s. per lb.

SODIUM POTASSIUM TARTRATE (ROCHELLE SALT).—80s. to 85s. per cwt., according to quantity.

SODIUM SALICYLATE.—Powder, 1s. 10d. to 1s. 11d. per lb. Crystal, 1s. 11d. to 2s. per lb.

SODIUM SULPHIDE, PURE RECRYSTALLISED.—10d. to 1s. 2d. per lb.

SODIUM SULPHITE, ANHYDROUS, £27 10s. to £28 10s. per ton, according to quantity; 1-cwt. kegs included.

SULPHONAL.—10s. 6d. per lb.

TARTAR EMETIC, B.P.—Crystal or powder, 2s. to 2s. 2d. per lb.

THYMOL.—11s. 6d. to 12s. 6d. per lb., according to quantity; natural, 17s. 6d. per lb.

Perfumery Chemicals

ACETOPHENONE.—10s. per lb.

AUBEPINE (EX ANETHOL).—12s. per lb.

AMYL ACETATE.—2s. per lb.

AMYL BUTYRATE.—5s. 6d. per lb.

AMYL SALICYLATE.—3s. per lb.

ANETHOL (M.P. 21/22° C.).—6s. per lb.

BENZYL ACETATE FROM CHLORINE-FREE BENZYL ALCOHOL.—2s. 3d. per lb.

BENZYL ALCOHOL FREE FROM CHLORINE.—2s. 3d. per lb.

BENZALDEHYDE FREE FROM CHLORINE.—2s. 9d. per lb.

BENZYL BENZOATE.—2s. 6d. per lb.

CINNAMIC ALDEHYDE NATURAL.—18s. per lb.

COUMARIN.—11s. per lb.

CITRONELLOL.—15s. per lb.

CITRAL.—9s. 6d. per lb.

ETHYL CINNAMATE.—10s. per lb.

ETHYL PHTHALATE.—3s. per lb.

EUGENOL.—9s. 9d. per lb.

GERANIOL (PALMAROSA).—19s. per lb.

GERANIOL.—6s. to 10s. 6d. per lb.

HELIOTROPINE.—4s. 10d. per lb.

ISO EUGENOL.—13s. 6d. per lb.

LINALOL.—Ex Shui Oil, 12s. per lb. Ex Bois de Rose, 17s. per lb.

LINALYL ACETATE.—Ex Shui Oil, 15s. per lb. Ex Bois de Rose 18s. 6d. per lb.

METHYL ANTHRANILATE.—9s. 3d. per lb.

METHYL BENZOATE.—4s. 6d. per lb.

MUSK KETONE.—36s. per lb.

MUSK XYLOL.—8s. 6d. per lb.

NEROLIN.—3s. 9d. per lb.

PHENYL ETHYL ACETATE.—12s. per lb.

PHENYL ETHYL ALCOHOL.—10s. per lb.

RHODINOL.—28s. 6d. per lb.

SAFROL.—1s. 6d. per lb.

TERPINEOL.—1s. 6d. per lb.

VANILLIN.—18s. 6d. to 19s. 6d. per lb.

Essential Oils

ALMOND OIL.—11s. 6d. per lb.

ANISE OIL.—3s. 6d. per lb.

BERGAMOT OIL.—31s. 6d. per lb.

BOURBON GERANIUM OIL.—12s. per lb.

CAMPBOR OIL.—63s. 6d. per cwt.

CANANGA OIL, JAVA.—20s. per lb.

CINNAMON OIL, LEAF.—5½d. per oz.

CASSIA OIL, 80/85%.—8s. 9d. per lb.

CITRONELLA OIL.—Java, 85/90%, 2s. 4d. per lb. Ceylon, pure, 2s. 1d. per lb.

CLOVE OIL.—6s. 9d. per lb.

EUCALYPTUS OIL, 70/75%.—2s. per lb.

LAVENDER OIL.—French 38/40%, Esters, 21s. per lb.

LEMON OIL.—9s. per lb.

LEMONGRASS OIL.—4s. 6d. per lb.

ORANGE OIL, SWEET.—9s. 9d. per lb.

OTTO OF ROSE OIL.—Bulgarian, 70s. per oz. Anatolian, 30s. per oz.

PALMA ROSA OIL.—9s. 9d. per lb.

PEPPERMINT OIL.—Wayne County, 25s. 6d. per lb. Japanese, 9s. 6d. per lb.

PETITGRAIN OIL.—8s. 3d. per lb.

SANDALWOOD OIL.—Mysore, 26s. per lb. Australian, 17s. 3d. per lb.

London Chemical Market

The following notes on the London Chemical Market are specially supplied to THE CHEMICAL AGE by Messrs. R. W. Greeff & Co., Ltd., and Messrs. Chas. Page & Co., Ltd., and may be accepted as representing these firms' independent and impartial opinions.

London, December 22, 1926.

THE uptake in chemicals is naturally slackening off in view of the approaching holidays and stocktaking period.

The outlook is, however, better than it has been for some time and a revival of business is confidently looked for in the new year.

There are few changes in prices, and it is satisfactory to note that there is a slight improvement in export inquiry.

General Chemicals

ACETONE is quiet at about £62 per ton.

ACID ACETIC is in good demand for both home trade and export; prices unchanged.

ACID CITRIC is a nominal market at about 1s. 2½d. per lb.

ACID FORMIC is in good demand, with price unchanged.

ACID LACTIC is quoted at £45 per ton for 50% by weight; demand rather slow.

ACID OXALIC.—Greater interest is taken in this article, although transactions are in small quantities; price 3½d. to 3¾d. per lb.

ACID TARTARIC.—The market is lifeless, but the undertone is firm at 11¼d. per lb.

ALUMINA SULPHATE is in fair demand at £6 to £6 5s. per ton for high grade material.

AMMONIUM CHLORIDE.—The demand is only small; price about £19 per ton.

BARIUM CHLORIDE is quiet at £9 10s. to £9 15s. per ton.

COPPER SULPHATE is in fair inquiry at about £23 10s. per ton.

CREAM OF TARTAR.—The advance in prices has been fully maintained, to-day's quotation being £80 to £82 per ton.

EPSOM SALTS.—Unchanged at £5 10s. to £5 15s. per ton.

FORMALDEHYDE is a firm market at about £43 per ton.

LEAD ACETATE is firm at £44 to £45 per ton for white, with the usual difference for brown.

METHYL ACETONE is firm at £58 to £62 per ton, the higher grades being particularly scarce.

METHYL ALCOHOL is unchanged at £46 to £48 per ton.

POTASSIUM CHLORATE is quoted 3½d. per lb.

POTASSIUM PERMANGANATE is without feature; price 7½d. per lb. for B.P.

POTASSIUM PRUSSIAN is firmer at 7½d. per lb.; makers are sold well ahead.

SODA ACETATE is a quiet market at about £20 to £20 10s. per ton.

SODA BICHROMATE is in active demand; price unchanged.

SODA CHLORATE is in fair inquiry at 3½d. per lb.

SODA NITRITE is steady at £19 15s. per ton to £20 per ton.

SODA PHOSPHATE.—Unchanged.

SODA PRUSSIAN is short; price 4½d. per lb.

SODA SULPHIDE.—Good business has been passing for next year; price £13 per ton for concentrated and £8 17s. 6d. for crystals.

ZINC SULPHATE.—Unchanged.

Coal Tar Products

The market generally for coal tar products is quiet, owing to the approach of the Christmas vacation.

90's BENZOL is quoted at 2s. 1d. per gallon on rails, while the motor quality is quoted at 1s. 11½d. to 2s. per gallon.

PURE BENZOL is worth from 3s. 9d. to 4s. per gallon.

CREOSOTE OIL is unchanged at 7½d. to 8d. per gallon on rails in the country, while the price in London is from 8½d. to 9d. per gallon at works.

CRESYLIC ACID is quoted at 2s. 2d. per gallon on rails for the pale quality 97/99%, while the dark quality 95/97% is worth 2s. 1d. per gallon.

SOLVENT NAPHTHA is slightly weaker and is quoted at about 1s. 10d. per gallon on rails.

HEAVY NAPHTHA is unchanged at 1s. 6d. to 1s. 7d. per gallon on rails.

NAPHTHALENES are also unchanged, the 76/78 quality being quoted at £8 to £9 per ton, while the 74/76 quality is worth about £8 to £8 5s. per ton, at makers' works.

PITCH continues to show a considerable difference between buyers' and sellers' ideas of value. To-day's price varies between 140s. and 180s., f.o.b. U.K. ports.

Latest Oil Prices

LONDON.—LINSEED OIL firm and occasionally 2s. 6d. higher; spot, £30 15s., ex mill; December, £29 17s. 6d.; January-April, £30 2s. 6d.; May-August, £30. RAPE OIL quiet; crude, extracted, £45 10s.; technical, refined, £47 10s., ex wharf. COTTON OIL steady; refined common edible, £38; Egyptian, crude, £31 10s.; deodorised, £40. TURPENTINE quiet, and 6d. to 9d. per cwt. lower; American, spot, 61s.; January-April and May-June, 62s.

HULL, December 21.—LINSEED OIL, naked, spot to January-April, £30 12s. 6d.; May-August, £30 7s. 6d. COTTON OIL, naked Bombay crude, £30 10s.; Egyptian, crude, £31 7s. 6d.; technical, £34 10s.; deodorised, £37. PALM KERNEL OIL.—Crushed, naked, 5½ per cent., £38. GROUNDNUT OIL.—Crushed/extracted, £42; deodorised, £46. SOYA OIL, extracted and crushed, £34 10s.; deodorised, £38. RAPE OIL, crude/extracted, £45; refined £47 per ton. COD OIL, spot, 30s. 9d. per cwt. barrels, net cash terms, ex mill. CASTOR OIL unchanged.

Nitrogen Products

EXPORT.—During the last week the sulphate of ammonia position has remained unchanged; the export sales have been negligible. The price remains at £11 5s. per ton f.o.b. U.K. port in single bags, but this price for the most part is a nominal one. The position in other countries remains comparatively quiet, as buyers are using summer purchases rather than coming into the market again for spring requirements.

HOME.—The continuance of production at the collieries has led to a reduction in forward buying. It is reported that merchants are buying now on a hand-to-mouth basis as the goods are required. There seems no likelihood of any further price changes.

NITRATE OF SODA.—The large leeway between sales last year and sales for the present year is being diminished to such a small extent that its complete elimination appears out of the question. As the consuming season comes nearer, the statistical position of the nitrate producers improves steadily. The reduction of production in Chile will tend to minimise the amount of stock carried over into the new year. Here, as well as in other countries, agriculturists complain of the price of nitrate, and this is bound to be reflected in reduced consumption.

Methylated Spirits Prices

THE METHYLATING CO., LTD., announce that their prices for methylated spirits and finish on and from December 20 have been as follows:

In One Delivery.	Industrial Spirits.	Pyridinised Industrial Spirits.	Mineralised Methylated Spirits.
500 gallons	61 o.p. 64 o.p.	61 o.p. 64 o.p.	61 o.p. 64 o.p.
100 "	2s. 5d. 2s. 6d.	2s. 7d. 2s. 8d.	—
30 "	2s. 6d. 2s. 7d.	2s. 8d. 2s. 9d.	3s. 6d. 3s. 7d.
10 "	2s. 8d. 2s. 9d.	2s. 10d. 2s. 11d.	3s. 8d. 3s. 9d.
	2s. 10d. 2s. 11d.	3s. 0d. 3s. 1d.	3s. 10d. 3s. 11d.

Methylated resin finish 2d. per gallon extra, and methylated shellac finish, 8d. per gallon extra, over the prices quoted for pyridinised industrial methylated spirits.

THE SECOND (TRIENNIAL) EMPIRE Mining and Metallurgical Congress will be held in Canada in August and September, 1927. The opening session will be held in Montreal on August 22. The general secretary of the congress is Mr. G. C. Mackenzie, Drummond Building, Montreal, Canada.

AT THE TEXTILE INSTITUTE, Manchester, on Monday, at a joint meeting of the Manchester Section of the Society of Dyers and Colourists and the Institution of the Rubber Industry, Messrs. H. L. Hockney and C. W. Bancroft read a paper on "Cloth Dyeing Suitable for Rubber Proofing." After discussing dyeing and rubber-proofing processes, the authors described experiments to show that traces of mineral acids which would be quite innocuous in cotton cloth under ordinary circumstances would be sufficient to cause serious "tendering" during hot curing. The acceleration of the degradation of rubber when traces of metals were present was also mentioned, the authors considering that for practical purposes cloth containing more than 0.01 per cent. of copper was unsuitable for rubber-proofing. Certain greases and oils in woollen materials were another cause of more rapid perishing of the rubber. The authors also spoke of the effect of the curing processes on the dyestuffs used on the material.

Scottish Chemical Market

The following notes on the Scottish Chemical Market are specially supplied to THE CHEMICAL AGE by Messrs. Charles Tennant and Co., Ltd., Glasgow, and may be accepted as representing the firm's independent and impartial opinions.

Glasgow, December 22, 1926.

INQUIRIES for heavy chemicals still remain good, although it is not likely that any important quantities will be called for before the end of the year. Prices both for home and continental products steady, with the exception of caustic potash, the price of which has been reduced by the syndicate.

Industrial Chemicals

ACETIC ACID.—98/100%, £55 to £67 per ton, according to quality and packing, c.i.f. U.K. ports; 80% pure, £37 to £38 per ton; 80% technical, £37 to £38 per ton, c.i.f. U.K. ports.

ACID BORIC.—Crystal, granulated or small flakes, £37 per ton; powdered, £39 per ton, packed in bags, carriage paid U.K. stations.

ACID CARBOLIC, ICE CRYSTALS.—In good demand and price unchanged at 7½d. per lb., delivered or f.o.b. U.K. ports.

ACID CITRIC, B.P. CRYSTALS.—Unchanged at 1s. 3d. per lb., less 5% ex store, with demand poor. Quoted 1s. 2½d. per lb., less 5% ex wharf, prompt shipment from the Continent.

ACID HYDROCHLORIC.—In little demand. Price 6s. 6d. per carboy, ex works.

ACID NITRIC, 80%.—Usual steady demand and price unchanged at £23 5s. per ton, ex station, full truck loads.

ACID OXALIC, 98/100%.—In moderate demand and price unchanged at about 3½d. per lb., ex store, spot delivery. Quoted 3½d. per lb., c.i.f. U.K. ports, prompt shipment from the Continent.

ACID SULPHURIC, 144%.—£3 12s. 6d. per ton; 168%, £7 per ton, ex works, full truck loads. Dearsenicated quality, 20s. per ton more.

ACID TARTARIC, B.P. CRYSTALS.—In moderate demand and price unchanged at about 11½d. per lb., less 5% ex store, spot delivery. Offered for prompt shipment at about 11½d. per lb., less 5%, ex wharf.

ALUMINA SULPHATE, 17/18%, IRON FREE.—Spot material on offer at about £6 per ton, ex store. Quoted £5 8s. 6d. per ton, c.i.f. U.K. ports. Prompt shipment from the Continent.

ALUM. POTASH.—Lump quality offered from the Continent at £7 15s. per ton, c.i.f. U.K. ports. Crystal powder, £7 10s. per ton, c.i.f. U.K. ports. Lump material on spot quoted £8 17s. 6d. per ton, ex store. Crystal powder, £8 10s. per ton, ex store.

AMMONIA ANHYDROUS.—Imported material selling at about 11½d. to 11½d. per lb., ex wharf, containers extra and returnable.

AMMONIA CARBONATE.—Lump, £37 per ton; powdered, £39 per ton, packed in 5 cwt. casks, delivered or f.o.b. U.K. ports.

AMMONIA LIQUID, 88%.—Unchanged at about 2½d. to 3d. per lb., delivered, according to quantity.

AMMONIA MURIATE.—Grey galvanisers' crystals of British manufacture quoted £23 10s. to £24 10s. per ton, ex station. Continental make on offer at about £21 per ton, c.i.f. U.K. ports. Fine white crystals of Continental manufacture quoted £18 10s. per ton, c.i.f. U.K. ports.

ARSENIC, WHITE POWDERED.—Spot material quoted £19 10s. per ton, ex store; offered for early delivery at £18 15s. per ton, ex wharf.

BARIUM CARBONATE, 98/100%.—White powdered quality quoted £6 15s. per ton, c.i.f. U.K. ports.

BARIUM CHLORIDE, 98/100%.—Large white crystals offered from the Continent at about £8 2s. 6d. per ton, c.i.f. U.K. ports. Spot material now quoted £9 15s. per ton, ex store.

BARYTES.—English material unchanged at £5 5s. per ton, ex works. Continental quoted £5 per ton, c.i.f. U.K. ports.

BLEACHING POWDER.—Spot material now quoted £9 per ton, ex stations. Contracts 20s. per ton less. Continental on offer at about £7 10s. per ton, c.i.f. U.K. ports.

BORAX.—Granulated, £22 10s. per ton; crystals, £23 per ton; powdered, £24 per ton, carriage paid U.K. stations.

CALCIUM CHLORIDE.—English manufacturers' price unchanged at £5 12s. 6d. to £5 17s. 6d. per ton, ex station. Continental on offer at £3 12s. 6d. per ton, c.i.f. U.K. ports.

COPPERAS, GREEN.—Unchanged at about £3 10s. per ton, f.o.r. works, or at £4 12s. 6d. per ton, f.o.b. U.K. ports, for export.

COPPER SULPHATE.—English material unchanged at about £23 5s. per ton, f.o.b. U.K. ports. Continental on offer at £22 10s. per ton, ex wharf.

FORMALDEHYDE, 40%.—Spot material on offer at £40 per ton, ex store. Quoted £38 per ton, c.i.f. U.K. ports, prompt shipment.

GLAUBER SALTS.—English material quoted £4 per ton, ex store or station. Continental on offer at about £2 15s. per ton, c.i.f. U.K. ports.

LEAD, RED.—Imported material on offer at £36 15s. per ton, ex store.

LEAD, WHITE.—Quoted £37 5s. per ton, ex store.

LEAD, ACETATE.—White crystals quoted £44 5s. per ton, c.i.f. U.K. ports. Brown at £40 10s. per ton, c.i.f. U.K. ports. White crystals quoted £45 5s. per ton, ex store, spot delivery.

MAGNESITE, GROUND CALCINED.—Quoted £8 10s. per ton, ex store, in moderate demand.

POTASH CAUSTIC, 88/92%.—Syndicate advise reduction to £27 5s. per ton, c.i.f. U.K. ports, minimum 15 ton lots. Liquid 50° unchanged at £14 per ton, c.i.f. U.K. ports.

POTASSIUM BICHROMATE.—Unchanged at 4½d. per lb., delivered.

POTASSIUM CARBONATE, 96/98%.—Quoted £25 5s. per ton, ex wharf, early delivery. Spot material on offer at £26 10s. per ton, ex store. 90/94% quality quoted £22 5s. per ton, c.i.f. U.K. ports.

POTASSIUM CHLORATE, 98/100%.—Powdered quality offered from the Continent at £24 10s. per ton, c.i.f. U.K. ports. Crystals £2 per ton extra.

POTASSIUM NITRATE (SALTPETRE).—Quoted £22 per ton, c.i.f. U.K. ports. Prompt shipment from the Continent. Spot material about £24 per ton, ex store.

POTASSIUM PERMANGANATE, B.P. CRYSTALS.—Quoted 6½d. per lb., ex store, spot delivery. On offer for early shipment at 6½d. per lb., ex wharf.

POTASSIUM PRUSSIAN, YELLOW.—Still in good demand. Spot material quoted 7½d. per lb., ex store. On offer from the Continent at 7½d. per lb., ex wharf, prompt shipment.

SODA CAUSTIC.—76/77%, £17 10s. per ton; 70/72%, £16 2s. 6d. per ton. Broken, 60%, £16 12s. 6d. per ton. Powdered, 98/99%, £20 17s. 6d. per ton. All carriage paid U.K. stations, spot delivery. Contracts 20s. per ton less. Manufacturers advise reductions of 20s. to 12s. 6d. per ton on prices for next year's delivery.

SODIUM ACETATE.—English material quoted £22 10s. per ton, ex store. Continental on offer at about £19 per ton, c.i.f. U.K. ports.

SODIUM BICARBONATE.—Refined recrystallised quality £10 10s. per ton, ex quay or station. M.W. quality 30s. per ton less.

SODIUM BICHROMATE.—Prices for spot delivery unchanged at 3½d. per lb., delivered. Manufacturers advise a reduction of ½d. per lb. as from January 1 next.

SODIUM CARBONATE (SODA CRYSTALS).—£5 to £5 5s. per ton, ex quay or station. Powdered or pea quality, £1 7s. 6d. per ton more; alkali, 59%, £8 12s. 3d. per ton, ex quay or station.

SODIUM HYPOSULPHITE.—Large crystals of English manufacture quoted £9 per ton, ex station, minimum 4 ton lots; pea crystals, photographic quality, £14 10s. per ton, ex store, spot delivery. Continental commercial crystals quoted £8 15s. per ton, ex store.

SODIUM NITRATE.—Ordinary quality quoted about £12 12s. 6d. per ton, ex store. Refined quality 5s. per ton extra.

SODIUM NITRITE, 100%.—£21 5s. per ton, ex store, spot delivery.

SODIUM PRUSSIAN (YELLOW).—Quoted 4½d. per lb., ex store, spot delivery. Still in good demand. Offered for prompt shipment from the Continent at 4½d. per lb., ex wharf.

SODIUM SULPHATE (SALTCAKE).—Prices for home consumption, £3 10s. per ton, ex works. Good inquiry for export and higher prices obtainable.

SODIUM SULPHIDE, 60/62%.—Solid, £13 5s. per ton; broken, £14 5s. per ton; flake, £15 5s. per ton; crystals, 31/34%, £8 12s. 3d. per ton. All delivered buyers' works U.K. Minimum 5 ton lots, with slight reduction for contracts; 60/62%, solid quality, offered from the Continent at about £8 15s. per ton, c.i.f. U.K. ports. Broken quality 15s. per ton more. Crystals, 30/32%, about £6 10s. per ton, c.i.f. U.K. ports.

SULPHUR.—Flowers, £12 5s. per ton; roll, £11 per ton; rock, £11 per ton; floristella, £10 10s. per ton; ground American, £9 15s. per ton. Ex store, spot delivery. Prices nominal.

ZINC CHLORIDE.—British material, 98/100%, quoted £24 15s. per ton, f.o.b. U.K. ports; 98/100%, solid, on offer from the Continent at about £21 15s. per ton, c.i.f. U.K. ports; powdered, 20s. per ton extra.

ZINC SULPHATE.—Continental make on offer at about £11 per ton, ex wharf.

NOTE.—The above prices are for bulk business and are not to be taken as applicable to small parcels.

Coal Tar Intermediates

SODIUM NAPHTHIONATE.—1s. 8d. to 1s. 9d. per lb. Some home inquiries.

BENZIDINE BASE.—3s. 3d. per lb. Some home inquiries.

META TOLUYLENE DIAMINE.—3s. 3d. per lb. Some home inquiries.

ALPHA NAPHTHYLAMINE.—1s. 3d. per lb. Some home inquiries.

SULPHANILIC ACID.—9d. per lb. per 100%. Some home inquiries.

Company News

BENN BROTHERS, LTD.—An interim dividend of $6\frac{1}{2}$ per cent., less tax, has been declared, payable on January 1.

REEVES AND SONS.—An interim dividend of $2\frac{1}{2}$ per cent., less income tax, is payable on January 20, on the ordinary shares.

ASBESTOS CORPORATION OF CANADA.—A dividend of $1\frac{1}{2}$ per cent. has been declared on the preferred stock, payable on January 15.

HUELVA COPPER AND SULPHUR CO.—At the general meeting on December 15 a dividend of 2s. per share was declared, payable on December 28.

YORKSHIRE DYEWARE AND CHEMICAL CO.—The company announces a dividend at the rate of 5 per cent., per annum, less tax 4s., payable in January.

ABERTHAW AND BRISTOL CHANNEL PORTLAND CEMENT.—The directors announce an interim dividend of 6 per cent., less income tax, on the ordinary shares, payable on January 1.

ROOIBERG MINERALS DEVELOPMENT CO.—For the half-year ending December 31, an interim dividend of $3\frac{1}{2}$ per cent. has been declared, payable on February 8. A year ago $2\frac{1}{2}$ per cent. was paid.

SHAWINIGAN WATER AND POWER CO.—A dividend of \$2 per share has been declared on the common shares for the quarter ended December 31, payable on January 10, to shareholders of record on December 24.

JOSEPH NATHAN AND CO., LTD.—The directors report that cabled information indicates that the company's accounts for the year ended September 30 last show a net result, subject to audit, of £53,041, compared with £50,693 last year. The report and accounts will be issued in March next, when the annual general meeting will be held.

EGYPTIAN SALT AND SODA CO.—The net profit for the year ended August 31 last was £E.25,454,824. The dividend of 5 per cent. on the share capital absorbs £E.24,267,360, leaving a balance of £E.1,187,464, which, with the balance of £E.40,966,162 brought forward, leaves to be carried forward a total of £E.42,153,626. A similar dividend was paid a year ago.

DE BEERS CONSOLIDATED MINES.—In respect of the financial year ending June 30 next, an interim dividend of 20 per cent. has been declared on the preference shares, and an interim dividend of 30 per cent. on the deferred. Both dividends will be subject to British income tax, and the date of payment will be announced later. A year ago the interim dividend on the ordinary shares was 25 per cent.

NOVOCRETE AND CEMENT PRODUCTS CO.—The report for period ended June 30, 1926, states that there have been serious delays in completing the company's factory at Park Royal, and it was not until June of this year that an order could be given for additional work and modifications necessary to complete the factory. Between December and April, in conjunction with an influential company in North, a factory was equipped near Liverpool to manufacture Novocrete products for that district, a separate company being formed for the purpose, styled Novocrete and Cement Products Co. (Northern Area), Ltd. Certain licences have been granted in America, but progress there has been slow. Owing to the coal strike sales expected have not materialised, but, on the other hand, a considerable amount of propaganda work has been accomplished, and the directors therefore propose carrying the whole of expenditure for year, less sales and stock, to a suspense account. During June arrangements were completed with certain large shareholders, under which an additional £20,000 of the ordinary shares were subscribed for at par. Park Royal factory was completed by October and production has been steadily increasing since that date. It is proposed that from June 30 last deferred shares carry a fixed non-cumulative dividend of 10 per cent. per annum. The annual meeting will be held at 20, Buckingham Gate, London, on December 30, at 12 noon.

New Chemical Trade Marks

Applications for Registration

This list has been specially compiled for us by Mr. H. T. P. Gee, Patent and Trade Mark Agent, Staple House, 51 and 52, Chancery Lane, London, W.C.2, from whom further information may be obtained, and to whom we have arranged to refer any inquiries relating to Patents, Trade Marks and Designs.

Opposition to the Registration of the following Trade Marks can be lodged up to January 15, 1927.

"CRAB TREE."

Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives, but not including paints, pigments, enamels, colours and varnishes and not including any goods of a like kind to any of these excluded goods. Class 1. J. A. Crabtree and Co., Ltd., Lincoln Works, Lincoln Road, Walsall; manufacturers. November 4, 1926. (To be Associated. Sect. 24.)

"YAMMEL."

474,977. Paints, varnishes and enamels. Class 1. S. R. Love and Sons, 7, Hartfield Road, Wimbledon, London, S.W.19; builders' merchants. November 17, 1926.

"FLOXIN."

474,878. Class 2. Sheep Dip. Abol, Ltd., Beltring, Paddock Wood, Kent; manufacturers. November 13, 1926.

Tariff Changes

BRITISH INDIA.—The Indian Trade Journal, dated November 25, 1926, contains a notification, No. 55, dated November 20, 1926, which has the effect of prohibiting the bringing into British India of any of the following articles among others: raw opium; prepared opium; coca leaves; medicinal opium; crude cocaine and ecgonine; morphine, diacetylmorphine, cocaine and their respective salts; all preparations official and non-official (including the so-called anti-opium remedies) containing more than 0.2 per cent. of morphine or more than 0.1 per cent. of cocaine; all preparations containing diacetylmorphine; galenical preparations (extract and tincture) of Indian hemp; and Indian hemp and bhang. The prohibitions are relaxed in some cases when the importation is on behalf of the Government of India or a local Government, or under their authorisation, etc.

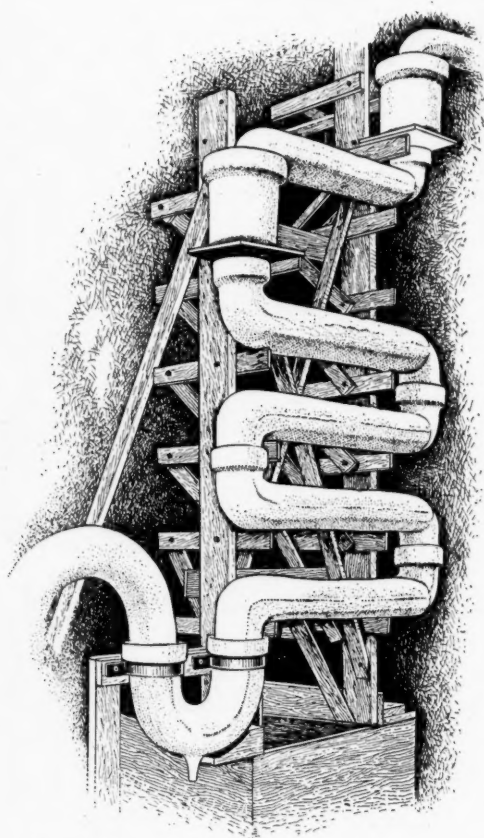
Action Against Silica Gel Corporation

In the King's Bench Division on Monday, December 13, Mr. Justice Rowlatt gave judgment for £17,448 with seven-eighths of the costs in favour of the Medway Oil and Storage Co., Ltd., of Gracechurch Street, London, E.C., in their action for damages against the Silica Gel Corporation, of Grosvenor Gardens, Westminster. Plaintiffs had claimed damages for alleged breach of warranty in supply of a silica gel refining unit and his Lordship had held that the defendants were liable in damages. With regard to the cost of the plant his Lordship allowed the plaintiffs £7,045 as direct damage. Under the head of the erection of the plant and overhead charges £7,000 were allowed and an allowance of £766 was made in respect of re-treating the oil after its passage through the faulty machine. For the acid and distilling process rendered necessary he allowed £140 with an additional £257 representing the quantum of loss in the process. £500 was also allowed in respect of time lost by the plaintiffs consequent upon the faulty plant's use. His Lordship did not think the plaintiffs could recover anything for the loss of custom or reputation, but he allowed an agreed figure of £1,740 for certain losses.

SIR MAX MUSPRATT presided on Thursday, December 16, at the annual luncheon of the Widnes Chamber of Commerce, of which he is president.

SIR DAVID MASSON has been appointed by the Commonwealth Government, Australia, as chairman of the Victorian State Committee of the Council for Scientific and Industrial Research.

The "VITREOSIL"



COLUMN OF "VITREOSIL" ABSORPTION VESSELS.

System of HYDROCHLORIC ACID ABSORPTION

THESE VESSELS set up Vertically one above the other can be thoroughly Water Cooled.

Economies of Floor Space and Efficiency of Operation are secured. There are no submerged joints.

In this System an intimate contact of the gas with the liquid is secured by means of the liquid curtain formed by the drops falling from the central depression and through which all the gas must pass.

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Scientific Apparatus and Requisites

A NEW edition of the catalogue of general and industrial laboratory apparatus and requisites supplied by them has been issued by A. Gallenkamp and Co., Ltd., of 19 and 21, Sun Street, Finsbury Square, London, E.C.2. It is a handsome volume of 1,210 pages, and deals with a range of products which is astonishingly large—so large, indeed, that it is impossible to give an adequate idea of it in small compass, for the articles included seem to comprise the needs of every kind of laboratory worker. Turning over the pages at random, one finds, for example, low pressure digesters, vacuum evaporating and distilling apparatus, glassblowers' requisites, shaking machines, a great variety of glassware, apparatus for gas analysis, furnaces, hydrometers, katathermometers for measuring the efficiency of ventilation, ovens, water ovens and stills, vacuum pumps, balances, weights, thermo-regulators, electrical and electrolytic apparatus, lecture demonstration apparatus, spectroscopes, spectrographs, spectrometers, centrifuges, botanical and plant physiology apparatus, apparatus for micro-analysis, sterilisers, microscopes and requisites, calorimeters, tintometers and colorimeters, pyrometers, tensile strength apparatus, requisites for the teaching of anatomy and physiology, cupboards, museum cases, calipers, micrometers, measuring apparatus, etc. A long list is given of text books on a large range of subjects, supplied by the firm; and finally a very comprehensive list of chemicals for analytical purposes and research. An index nearly 50 pages in length testifies at once to the comprehensiveness of the products supplied and to the thoroughness of the indexing.

Chemical Dealer's Bankruptcy

UNDER a winding up order recently made against Kathijax, Ltd., chemical dealers, of 109, Kingsway, W.C., the statutory meetings of the creditors and of the shareholders were held on Friday, December 17, at the Board of Trade Offices, 33, Carey Street, London, W.C. The statement of affairs disclosed unsecured liabilities £1,729 and net assets £128. The paid up capital was £277, and the total deficiency as regards shareholders was £1,677.

The company was registered as a private one in August, 1925, with a nominal capital of £1,000. Mr. A. Griffiths was the promoter, and was appointed a director and conducted the business with the assistance of a manager. The company appears to have been in financial difficulties throughout. In June last the stocks, fixtures and fittings, goodwill, trade formulae and trade marks were disposed of for a consideration of £275. Mr. Griffiths attributed the failure of the company to heavy expenses in advertising which had so far proved unremunerative and to his inability to advance further moneys on loan to meet liabilities. He had advanced over £1,000 for the business, and had withdrawn all claims as a creditor. A resolution was passed for the appointment of Mr. H. S. Blouet, 47, Charing Cross Road, London, as liquidator, with the assistance of a committee of inspection.

U.S.A. and Gas Warfare

THE treaty prohibiting the use of asphyxiating, poisonous, or other gases in warfare has been referred back to the United States Senate Committee on Foreign Relations without ratification. This is a method of disposing of the matter without open defeat of a measure which had the support of the Coolidge Administration. The fight against the treaty began several months ago, when the National Association of Chemical Defence, a private organisation of chemists and manufacturers, was formed. The association had ample financial backing, but its campaign has been effective chiefly because it was able to use the American Legion as the shield behind which it worked. At the last convention of the Legion, in Philadelphia, a resolution recording the opinion of the veterans that there should be no prohibition of the use of poison gas in warfare was slipped through without discussion, and from that moment it became possible to use the name of the Legion as support for the "lobbying" activities of the Association of Chemical Defence. As a general result it was known before the Treaty came up to the Senate that it would be impossible to secure the two-thirds vote necessary for ratification.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Receiverships

BELL (JOHN) AND CROYDEN, LTD. (R., 25/12/26.) N. D. Grundy, of 90, Cannon Street, E.C., was appointed receiver and manager by Order of Court dated December 10, 1926.

CROW MANUFACTURING CO., LTD. (R., 25/12/26.) F. F. Charles, of 52, Queen Victoria Street, E.C.4, was appointed receiver and manager on December 7, 1926, under powers contained in debenture dated July 4, 1925.

London Gazette, &c.

Companies Winding Up Voluntarily

GRAESSER (R.), LTD. (C.W.U.V., 25/12/26.) By special resolution, confirmed November 22, its undertaking and assets (with the exception of its investments) having been sold to the Graesser Monsanto Chemical Works, Limited, be wound up voluntarily. C. H. Beevers, chartered accountant, of 26, Park Row, Leeds, appointed liquidator.

NORRIS BROS., LTD. (C.W.U.V., 25/12/26.)

OLEOBLITZ THREE ARROW OIL CO., LTD. (C.W.U.V., 25/12/26.) R. K. Crane, Cathedral House, Paternoster Row, E.C.1, appointed liquidator, December 13.

URAL PETROLEUM SYNDICATE, LTD. (C.W.U.V., 25/12/26.) By special resolution, November 18, confirmed December 13, W. J. G. Pitt, 10 and 11, Lime Street, E.C.3, appointed liquidator. Meeting of creditors at liquidator's office, 12 noon, Thursday, December 30. Creditors' claims by January 17, 1927.

New Companies Registered

CHEMICALS AND FERTILIZERS, LTD, 41, Eastcheap, E.C.3. Registered December 16. Nom. capital, £5,000 in £1 shares. Importers, exporters, and manufacturers of and dealers in fertilisers and chemicals of all kinds, and particularly in nitrates and nitrogen products; iodines, acids, and other products, etc.

INDUSTRIAL SOLVENTS, LTD. Registered December 15. Nom. capital, £500 in 1s. shares. Manufacturers of and dealers in chemicals and chemical products; manufacturers and refiners of and dealers in salts, acids, alkalis, alcohol, ether, fuel oil, carbon dioxide, methylated spirit, drugs, etc. A subscriber: H. Newington, 14, Queen Victoria Street, London, E.C.4.

Benn Brothers' Other Journals

THE CABINET MAKER.—Review of the Year; Furniture Design in 1926; Woodworking Machinery and Practice, XX: Rotary Planing Machines.

THE ELECTRICIAN.—Determination of Rotational Velocities, by Perry A. Borden; Electricity Supply in Paris, by Col. E. Mercier; Wilkinson Thermal Storage Device.

THE FRUIT GROWER.—Fruit Industry and Christmas; A Rural Phantasy; Advice for the Beginner.

GARDENING ILLUSTRATED.—Achievements of the Year; Floral Decoration of Churches; Mysterious Mistletoe; The Old Trees at Cawdor.

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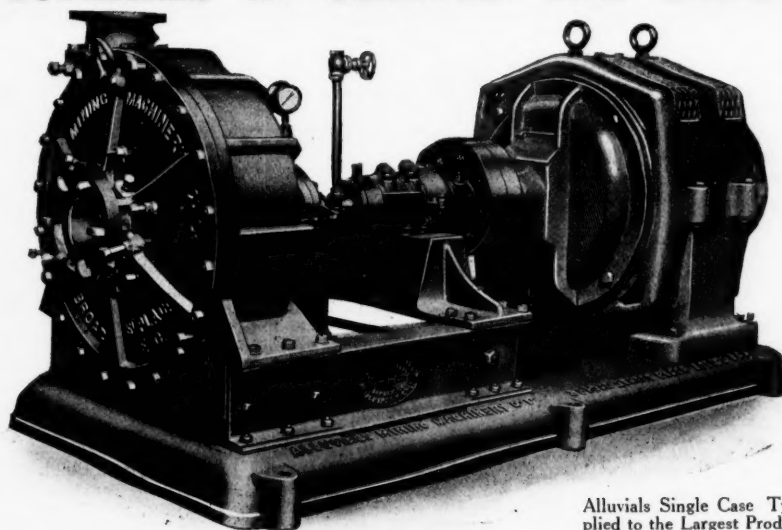
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The China Clay Trade Review

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Catalpo, Ltd., London.
Consolidated Mines of Cornwall, 32, Seething Lane, E.C.
Dartmoor China Clay Co., Ltd., 11, Queen Victoria St., E.C.4.
Dyer, Samuel J., Market Hill, St. Austell.
English China Clays, Ltd., St. Austell.
Fox, Roy & Co., Plymouth.
Grose & Stocker, Stoke-on-Trent.
Lovering, J., & Co., St. Austell.
New Halwyn China Clay Co., Y.M.C.A. Buildings, St. Austell.
Newquay China Clay Co., Ltd., Newquay, Cornwall.
North Goonbarrow China Clay Co., Ltd., 3, Victoria Place, St.
Austell.
Parkyn & Peters.
Pochin, H. D. & Co., Manchester.
Somerset Oxide and Ochre Co.
Tehidy Minerals, Ltd., 3, St. Petroc House, Bodmin, Cornwall.
Trehowal China Clay Co., Y.M.C.A. Buildings, St. Austell.
United China Clay Co., Ltd., 80, Bishopsgate, E.C.2.
Varcoes China Clays, Ltd., 107, Market Street, Manchester.
West Carclaze China Clay Co., St. Austell.
Wood, T.A.V., Ltd., Grant's Walk, St. Austell.

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Mid-Cornwall Transport Co., Ltd. (1922), Bodmin Road,
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Ryland, A., Cradley Heath, Staffs.

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Bute Works Supply Co., Ltd., 53, Cymric Buildings, Cardiff.

RAILWAY WAGONS.

Bute Works Supply Co., Ltd., 53, Cymric Buildings, Cardiff.
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ROPES.

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Blake, G. A., 11, High Cross Street, St. Austell.
Ludlow & Sons, Penzance.
Simpson, Spence & Young, London.
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Andrew Weir & Co., 21, Parliament Street, Liverpool.
Boag, Thos., & Co., Ltd., Greenock.
Cornish Mines Supplies Co., Ltd., St. Austell.
Dovener, J. H., & Co., Union Street, Liverpool.
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ley, N.12.

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The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests.
Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., Bouverie House, 154, Fleet Street, E.C.4. All communications relating to Advertisements, Subscriptions, etc., should be sent to the Manager, "The China Clay Trade Review," at this address. Telegrams—"Allangas, Fleet, London." Telephone—City 0244 (10 lines).

China Clay Association—Decision this Month

As briefly announced in our last issue, the negotiations for the formation of an "all-in" China Clay Association had reached a stage at which it was considered that a little more time in which to adjust certain details was necessary in order to permit of the scheme being brought to fruition.

Following the meeting of the "outsiders"—the designation given to those China Clay producers outside the existing Best China Clays Association—the Board of the Best Clays Association met to consider the request for more time, and conceded it on the distinct understanding that no contracts for next year are entered into by individual producers in the meantime.

The new time limit will be reached towards the end of the present month, when those representing the outside producers will be expected to be in a position to say whether or not they have been able to secure such a measure of support for the new scheme as will satisfy the Best Clays Association that successful co-operation with them in an "all-in" association is possible.

Executive Committee's Task

Since the meeting, the result of which we briefly recorded last month, we understand good progress has been made in the efforts to reconcile the claims of those who were not satisfied with the earlier bases suggested by the Executive Committee. Those bases, it should be borne in mind, were of a more or less tentative nature and arrived at in accordance with the information in the hands of the Executive Committee. The efforts at reconciliation referred to have not proceeded on the lines of making concessions to satisfy some at the expense of others, but to bring the formula, upon which the committee have been working, in accord with proved facts and figures that the producers concerned have been able to furnish.

The position in a nutshell is that the Best Clays Association and the "outsiders'" Executive Committee have agreed on the proportions of tonnage that can reasonably and fairly be allocated to each section based on actual previous records. It is the business of the Executive Committee to allocate its proportion on a pro rata basis among the outsiders, in the same way as those within the existing Association have already done their proportion amongst its members. To enable them to do this satisfactorily to all was the object of the postponement since agreed to by the Best Clays Association.

The Landowners' Position

As is natural with a body dependent upon a big output, the landowners have been watching the progress of events with interest not untinged with concern. In the leases under which most of the China Clay companies work are clauses that require the lessees to turn out and sell the maximum quantity of China Clay per annum, for the minimum rents merge into dues on tonnage from which the landowners receive their revenue. The China Clay landowners are therefore interested in seeing that the lessees produce and sell up to their capacity. Up to now the landowners have shown themselves to be reasonable individuals, and it is not anticipated that they will place any obstacle in the way of their lessees in the future, bearing in mind that any arrangement into which they enter is

with the object of securing for those who have put up capital, so that the landowners' properties may be worked, a reasonable return on the outlay.

Some landowners have taken exception to what has been called "the regulation of output" under the Association proposal.

Not Out to Profiteer

An Association of English China Clay producers can never develop into a profiteering organisation like some other trade organisations have done, because prices have always to be fixed with due regard to the prices of domestic clays in the countries to which China Clay is exported. The desire that has been so widely expressed and which is being entertained to such a great extent by the China Clay producers for an "all-in" trade organisation, arises from the legitimate ambition to secure for the industry a reasonable return upon the capital put into it. That is not possible at the present time when over-production leaves unprotected producers at the mercy of buyers.

If, unhappily, the negotiations that have been proceeding for the last few months should fail to bring about the formation of an "all-in" association, it will not be the adventurous capitalist and confiding shareholders alone who will suffer, but the landowners and workers as well.

Momentous Meeting

Since the above was written, notices have been issued by the secretary of the Proposed Association Executive Committee calling a meeting on Friday this week at St. Austell "for the purpose of deciding definitely whether or not the scheme for the formation of an association embracing the whole of the China Clay trade shall be adopted or abandoned." The notice adds the following ominous warning: "Owing to difficulties with about twelve firms, the Committee can see no hope of an association being formed unless these difficulties are overcome either before or at the meeting now called." The Lord-Lieutenant of Cornwall (Mr. J. C. Williams) is to preside at this momentous meeting on the eve of our going to press, and the result will be subsequently communicated to the Board of China Clay Producers, Ltd. (the Best Clays Association).

China Clay Production with Continental Coal

The China Clay industry is feeling the pinch of the coal strike more and more as accumulated stocks of home produced coal have dwindled. By the purchase of a large quantity of anthracite coal—the cargo of a vessel storm-bound on its way to America which had to put into a Cornish port and discharge—English China Clays, Ltd., have been able to carry on operations at their works by using it in conjunction with steam coal. This has enabled them to resume normal employment by restoring their men to a seven-hour day. Other firms have been making large purchases of Continental coal.

By adopting these and other expedients China Clay producers were able to keep their customers supplied though at much enhanced cost to themselves. The industry is anxious to maintain its markets and to give the foreign buyer no excuse for looking elsewhere for supplies or substitutes. In this it has so far succeeded.

China Clay for Porcelain and Pottery

Properties of Kaolin

CHINA Clay is known in the ceramic industry in the form of the very fine powder obtained by levigation of the products of hydrolysis and natural disaggregation of felspathic rocks, the chief constituent, namely, hydrated aluminium silicate ($\text{Al}_2\text{O}_3 \cdot 2 \text{SiO}_2 \cdot \text{H}_2\text{O}$), being almost free from titanium and vanadium oxides, so that it will remain white after being exposed to a temperature of 1350° to 1400°C . When this condition is not realised and the China Clay is consequently unfit for use in porcelain, even though its plasticity is satisfactory, it is classed as common clay.

In a discussion of the present subject in *L'Industria*, it is stated that experimenters agree in taking Zettlitz kaolin as the standard of comparison in estimating the industrial value of plastic materials. According to recent analysis this kaolin contains 95 to 99 per cent. of aluminium silicate, part in the form of kaolinite and the remainder in an amorphous or colloidal state, with very small quantities of quartz, feldspar, mica, other minerals and traces of organic matter. Its composition varies within the following limits:—

	per cent.
Silica	45.60 to 47.83
Alumina	36.83 " 39.10
Iron oxide	0.43 " 1.01
Titanium	0.36 " 0.50
Lime	0.08 " 0.78
Magnesia	0.10 " 0.38
Potassium oxide	0.30 " 1
Sodium	0.27 " 0.70
Loss on calcination	12 " 14.10

The density is: dry, 2.63; heated to 800°C , 2.53; to 1000°C , 2.68; 1315°C , 2.67. The average size of the particles is 4.8μ and on a sieve with 1,000 meshes per sq. centimetre the kaolin leaves a residue of 0.02 per cent. The degree of subdivision can be approximately estimated from the volume of the clays and kaolin after being boiled in petroleum to eliminate hygroscopic water. After desiccation at 110°C it recovers 5.88 per cent. water when kept under a bell jar containing 10 per cent. sulphuric acid.

The amount of water necessary to make a paste which can be worked with the hands varies, according to different experimenters, from 42 to 58 per cent. To give it a liquid form for running there must be 65.3 per cent. of water or, when the necessary amount of soda is added, 47.2 per cent. will suffice. Plasticity is calculated as follows by the following experimenters:—Ashley, 1.335; Rieke, 10; Pfeifferkorn, 34 to 34.6. (Plasticity is proportional to the resistance to cutting displayed by kaolin when in the form of a workable paste. This method, due to Binns, is the best industrially).

Other Physical Properties

The shrinkage of hand-made objects after drying was found to be as follows:—

Water Content. Percentage.	Linear Shrinkage. Percentage.
42	4.2 (Wohlin)
44.3	4.2 (Kallauner and Barta)
45.5	5.9 (Kallauner and Pexider)
45.7	6.4 (S.V.U.S.)
53.8	5.2 (Rieke)

In firing, the commencement of dissociation occurs at 575°C , with absorption of 3 calories, and an exothermic reaction begins at 950°C with development of 0.5 calorie per gram. The shrinkage from effect of firing is (per cent.):—At 900°C , 1.9; at 1000°C , 2.8; at 1100°C , 6.5; at 1300°C , 12.8; and at 1350°C , 13.8. Porosity or hygroscopic power decreases as follows after firing (figures given are percentage decreases): firing at 900°C , 31.9; 1000°C , 30.8; 1100°C , 22; 1300°C , 10.6; 1435°C , 6.5. The mechanical resistance, expressed in kilogrammes per sq. centimetre, is:—

	Traction.	Crushing.	Bending.
After desiccation at 110°C	2.5	14	2.7
" firing " 900°C	11.9	95	33.4
" " " 1000°C	12	110	40.5
" " " 1100°C	33.7	270	87.1
" " " 1300°C	64.5	712	280

The aforesaid characteristics of Zettlitz kaolin may vary within somewhat wide limits in the different commercial kaolins according to the greater percentage of impurities and that of aluminium silicate and especially the state of subdivision of the latter, manifested by greater or less plasticity.

Devon Ball Clays

Their Origin, Formation, and Properties

THE West Country yields from under the surface of its soil a number of different kinds of clays. In the Mid Cornwall area there is an extensive China Clay industry, known throughout the world for the clays produced there, and in Devon, around Newton Abbot in the east and Hatherleigh in the north, there are produced some of the best Ball Clays in the world.

In the minds of many people China Clays and Ball Clays are identical, and they are often confused in the Press. China Clays, on the one hand, are washed from the altered granite or so-called China Clay rock, while Ball Clays, on the other hand, are dug from the earth like coal and sold without further purification. The different qualities obtained are graded, but there is no purification in the sense that China Clays are purified or refined by levigation. Although China Clays and Ball Clays differ widely in colour, the best China Clays being generally white and the best Ball Clays dark or black, they both appear to have a common origin in the granite.

Deposition of Ball Clay

The process of washing the granite of the Mid Cornwall area to obtain China Clay was performed countless ages ago in parts of the Dartmoor by rain. The formation of the Ball Clay deposits of Devon was probably somewhat as follows. The deluges of different ages since time immemorial washed away the soil, leaving the granite bare. Rain then washed very fine particles out of the granite and deposited them as mud in pools or shallows near by. A succeeding deluge then carried away with it the fine particles of mud, larger grains of sand and fragments of stone, and so on, the denuding and wearing of the granite being repeated many times. When the deluge ceased to rage and carry everything movable before it, it deposited the larger stone and coarse sand. The deposits became finer and finer as the stream flowed more peacefully, and when at length it formed a dam or lake with only a limited outlet towards the sea, the still water deposited its very fine particles and formed a seam or layer of Ball Clay. No Ball Clays have yet been found in those districts where any deluge from the hills had swift and easy access to the sea. It is only in those districts where the contour of the land necessitated the formation of a huge lake with only a limited outlet towards the sea, that Ball Clays have been discovered. When the water had ready access to the sea it carried its clay with it and deposited it in the English Channel. Thus Nature has done in parts of Devon what man is doing to-day in Mid Cornwall. The deposition or sedimentation of the particles in suspension in the water was only selective in so far as the size of the particles is concerned.

Properties of Ball Clay

From their mode of formation the Ball Clays of Devon should be intrinsically and chemically very similar to the China Clays of Cornwall. They are, in fact; but one of the most noticeable differences between them, apart from colour, is plasticity, i.e., the capacity or property of a clay when made into a paste with water and moulded, to retain its shape under the influence of gravity. Ball Clays generally have this property to a high degree, and on account of this they are extensively used for making models, for relief work, e.g., maps, etc. This property also, among others, makes Ball Clays attractive to pottery manufacturers, and it is said that some of the best of the old pottery owes much of its value to the particular Ball Clay used in its manufacture. The dark colour of some Ball Clays is due to carbonaceous or organic matter, which serves the same purposes as straw did in the manufacture of bricks in olden times. It is difficult to account for the plasticity of Ball Clays unless it be due to moisture and pressure. In certain parts of Cornwall tin miners of generations long past removed quantities of China Clay in their search for tin. These heaps of China Clay, which were separated from the parent bed, so to speak, and which have been subjected to external weathering influences for generations, exhibit plasticity to a high degree.

Ball Clays for export are shipped from Teignmouth on the south coast and from Fremington on the north coast, but large quantities of Ball Clays which go to America for her ceramic industry are shipped from Fowey. The industry is an important one, the annual production being about 90,000 tons.

E.J.L.

Fowey Harbour Dispute

Shipowners' Action Against Commissioners

In the Court of Appeal, on Thursday, July 8, before Lords Justices Bankes, Atkin, and Sargant, sitting with nautical assessors, the case of Richard Hughes and Co. and others *v.* Fowey Harbour Commissioners and Fred Collins was heard upon the appeal of the plaintiffs from the judgment of Mr. Justice Bateson in the Admiralty Division. The plaintiffs brought the action for a declaration that certain directions given by the defendants as to the entry of the plaintiffs' ships into Fowey harbour were void, invalid, and unenforceable, and for an injunction to restrain the defendants from attempting to enforce the directions. The directions, which purported to be made under Section 52 of the Harbours, Docks, and Piers Clauses Act (1847), were to the effect: (1) that vessels should not, between sunrise and sunset, proceed up Fowey harbour at more than three miles an hour; (2) that they should anchor at a particular spot indicated on a chart; (3) that they should not at any time proceed above Prime Cellars without the sanction of the harbour master; and (4) that they should not at any time be moved within the limit without previously notifying the harbourmaster, unless in either case they had a qualified pilot on board. Defendants contended that the directions were validly and duly issued under their statutory powers. Mr. Justice Bateson held that the directions were valid and dismissed the plaintiffs' claim for a declaration in costs, and from this result the plaintiffs now appealed. Mr. Dunlop, K.C., and Mr. R. K. Chappell appeared for the appellants, and Mr. Raeburn, K.C., and Mr. H. C. S. Dumas for the respondents.

Mr. Dunlop said that action was brought by Richard Hughes and Co. (of Liverpool) and other owners of a number of vessels which regularly traded to and from the port of Fowey to obtain a declaration that certain regulations or directions issued by the defendants were *ultra vires*, or an unlawful interference with the plaintiffs' right and their uses of the harbour. The main question in the case was whether the defendants, as the harbour authority, were entitled to compel the appellants to employ a pilot at the port of Fowey, and by making it intolerable for them if they did not do so. The appellants' case was that their business at the port could not be carried on in a reasonable way if they were compelled to obey the regulations or directions issued by the defendants. The alternative was to remain away from the port or to employ a pilot, which they were not bound by law to employ. A second question was whether the so-called directions were really directions which the harbourmaster was justified in giving under Harbours, Docks, and Piers Clauses Act (1847). He submitted they were not.

The Defence

Mr. Raeburn, K.C., for the Commissioners, said the case had been presented to the Court as though the Commissioners were unreasonable people who were striving to drive the appellants from the harbour or to induce them to take pilots. Nothing was further from the truth. Mr. Justice Bateson, who saw the witnesses, did not take that view—it was inconceivable that the Commissioners would without very good reason make regulations of that kind. The interests of the Commissioners were for the safety and efficient working of the port. A very considerable portion of the China Clay carried from Fowey was carried by Messrs. Hughes' vessels. It was inconceivable that the Commissioners should want to lose the revenue from that source—it was essentially in the interest of the port that directions should be given in order that vessels should be properly navigated in the port. With regard to the allegation that the Commissioners by the directions had endeavoured to force pilots on Messrs. Hughes, learned counsel said that none of the pilotage dues went into the pockets of the Commissioners.

It must be borne in mind, he said, that Fowey was not an easy port to manage in regard to the movement of ships.

The Judgment

Mr. Dunlop, K.C., for the appellants, having replied, Lord Justice Bankes in giving judgment allowing the appeal said it was from the judgment of a very experienced judge in matters relating to seamanship and navigation, and the appeal undoubtedly raised a question of some importance. Having stated the nature of the claim and the port, and the history

of the regulations of the port, he said the question was whether the directions or regulations were valid and enforceable and binding on the appellants. He had no doubt whatever that the Fowey Harbour authorities were acting in good faith, and that they were convinced that the regulations which imposed compulsory pilotage in Fowey should not have been withdrawn as they were in 1921. That, however, was not the question—but directions to be enforceable in future must be obviously reasonable in all possible conditions. That he did not think they were, and there would be a declaration that they were invalid.

Lord Justice Atkins and Sargant concurred.

The appeal was accordingly allowed with costs, and a declaration granted that the regulations were invalid and unenforceable.

Chinese Potters' Secrets

Chelsea Couple's Work to Fathom Them

In a Chelsea studio two people are working to re-discover a forgotten secret that died with the ancient Chinese potters. Mr. Charles Vyse, the master potter, and his wife are keeping vigil about their gigantic kilns, built to their own design, in the hope that they will obtain the knowledge which no one else possesses. The studio holds the result of but one year's firing. For it has only been in the last year that sufficient time has been found for the experiment. Previous research goes back to the time when Mr. Vyse was a potter apprentice earning three shillings a week, and carrying off gold medals for technique in modelling and pottery while still in his teens. In the course of an interview Mr. Vyse said, "What I am seeking—what I believe I am on the verge of finding—is the secret of that extraordinary stone-ware of the Sung Dynasty, A.D. 960-1260, to which no clue has been left us.

Clay Mixtures

"For instance, we have had to try from twenty to thirty different mixtures of the clay alone, for the glaze and clay get so intimately fired, and our kilns fire up to 1,400 Centigrade, a temperature which melts an ordinary clay. Quite 90 per cent. of the pots are useless and misshapen, owing to the intensity of the heat, but the intensity is essential for the development of certain colours in the glazes.

"How those Korean potters are to be envied! Knowledge handed from father to son, sometimes down to the thirteenth generation, the materials at their very doors, leisure in which to experiment, and allied to all, their unparalleled genius. Moreover, the son received from his father not merely the recipes; he received the greatest heritage a potter could leave his son: his clay. That is what we are missing. For old clay is so much finer and more resilient than the new. The basis of stoneware clay is, of course, kaolin, China Clay, and Petunze, Cornish stone. For our glazes we use the natural ore with all its impurities, before its virility is dispersed in the machine, and grind it ourselves with mortar and pestle, as they did. And, again as they did, we throw our pots on the primitive foot-wheel, for nothing more practical has as yet been invented.

"It is unbelievably difficult to achieve the perfect glaze. The ingredients are so human. They have likes and dislikes; feuds and infinities; some run to meet each other, others seem deliberately to take the wrong turning to avoid contact with the rest. The Chinese, artists always, made the most entrancing mystic names for their self-coloured glazes, such as 'the colour of the sky after rain,' 'the blue of the pruneskin,' 'the violet of wild apples,' 'the red of the bean blossom,' 'the hare's fur,' and 'the liquid dawn.'

The Bane of Mass Production

"To-day they are no longer making lovely things. The Chinese did their Ming, their famille rose, etc., purely for export, and they found that although the Occidental taste was faulty, the demand was great, so they ignored the taste and supplied the demand. In Japan, likewise, all the rubbish is sent to Europe and America. And it is the same with us," explained Mr. Vyse. "The big potteries are now machines. They are taking no more apprentices. I was the last apprentice Doultons ever took. I had no choice; my father, grandfather and great-grandfather had all been potters. I began with my 3s. in my early teens, and at 21 emerged a full-fledged potter, having been through every phase of the craft."

Anomalous Flocculation of Clay

Recent Research Results

SOME important investigations on the so-called anomalous flocculation of clay are in progress, and recently communications on the subject have appeared in the scientific press. Dr. A. F. Joseph and Mr. H. B. Oakley, of the Wellcome Tropical Research Laboratories, Khartoum, stated, in the course of a letter to *Nature* of May 1, that in recent years it had become common to speak of the flocculation of clay by calcium salts as being "anomalous," the particular anomaly being that whereas clay suspensions containing a little sodium chloride were stabilised by the addition of sodium hydroxide, in the case of calcium the flocculation was said to be facilitated rather than repressed by the addition of the alkali. Careful experiments, however, made with a highly purified clay suspension, had convinced them that this anomaly did not exist, and that calcium and sodium compounds behaved alike except in respect to the concentration required for flocculation. The following figures obtained by them show the concentration in equivalents of cation required for flocculation to be half completed in one hour, this being determined nephelometrically:

	Concentrations multiplied × 10,000.	
	Sodium.	Calcium.
All chloride.....	70	5.6
All hydroxide.....	480	16.8
Two equivalents of chloride to one of hydroxide.....	560	19.5

These results, they pointed out, were parallel, and did not suggest anything more than that compounds of calcium were much more powerful flocculants than those of sodium.

In carrying out this work, however, a much more interesting phenomenon had been noticed. If to a dilute clay suspension were added gradually increasing quantities of certain mixtures of chloride and hydroxide, and the effect on the flocculation or otherwise of the clay determined nephelometrically after one hour's standing, it was found that the flocculating effect first increased very rapidly with concentration, then rapidly fell off, and then again increased without further falling off. The following table of results obtained by them shows this for a few mixtures, and also exhibits the similarity in behaviour between sodium and calcium compounds. "+" means flocculated (one-half or more down in one hour), and "-" means no flocculation observed in an hour.

Conc. × 1,000 for Sodium.	5	20	40	60	80	100	120	140	160	180	200
Conc. × 10,000 for Calcium.											
NaCl : NaOH, 50 : 1.....	-	+	+	+	+	+	+	+	+	+	+
NaCl : NaOH, 175 : 1.....	-	+	+	+	-	-	-	-	+	+	+
CaCl ₂ : Ca(OH) ₂ , 2 : 1.....	-	-	-	+	+	+	-	-	-	-	-

In the case of sodium compounds, the phenomenon was exhibited with ratios for chloride to hydroxide varying between 25 and 175 to one: for calcium it was only shown in the neighbourhood of the ratio 2 to 1. Other mixtures did not show a minimum in the flocculation curves.

Messrs. W. O. Kermack and W. T. H. Williamson replied to the above communication in the course of a letter published in *Nature* of June 12. They pointed out that it was doubtful whether the experiments referred to in the first part of the communication from Dr. Joseph and Mr. Oakley could be expected to show anomalous flocculation as ordinarily understood. In the first place, it had been suggested by Comber (*Journ. Agric. Sci.*, 1920, 10, 432; *loc. cit.*, 1921, 11, 460 *et seq.*; and *Trans. Faraday Soc.*, 1922, 17, 349) that the phenomenon referred to was dependent on the presence of colloidal silica in the outer surface of the particles, and the "highly purified clay" used by Dr. Joseph and Mr. Oakley might well have lost this coating. Further, the phenomenon was shown, not so much by differences in the minimum amount of ion required for flocculation, as by an increased rate of sedimentation when a sufficiency of the ion was present. It would be interesting to know whether the particular clay used would show the phenomenon of anomalous precipitation at higher concentrations of salts either alone or after the addition of colloidal silica.

It might be mentioned, they added, that with suspensions of kaolin they had obtained very marked anomalous precipitation in alkaline solution by calcium ions after the addition of small quantities of colloidal silica, although these suspensions did not exhibit this phenomenon when silica was not

present. They had also observed a similar effect with caesium chloride, although in this case the phenomenon, under certain conditions, might be delayed for approximately twenty-four hours. Ammonium and potassium salts gave similar results after still longer delays. The effect seemed to be related to the precipitating action of the cations of these salts on colloidal solutions of silica at pH greater than 7—a phenomenon which appeared to have been first described by Pappadà (*Gazzetta Chim. Ital.*, 1903, 33, (ii.), 272). The nature of the precipitate in this anomalous flocculation was quite different from that obtained at other concentrations of the ions and other reactions of the medium. For example, in the case of calcium chloride a voluminous and highly flocculent sediment separated in the first two or three minutes at concentrations exceeding $39 \times \frac{1}{10000}$ N, and at pH 8-9. At the end of such periods there was practically no flocculation apparent at corresponding concentrations of the salt in neutral or acid medium, or at any reaction or concentration of salt when silica was not present.

Secrets of Pottery Making

An Expert on the Art

IN a talk on ceramics at the Huddersfield Rotary Club, Rotarian Lewis Neaverson said that the process of pottery manufacture—to take a piece of clay, to mould it into a definite shape, to bake and to decorate it and to have then a permanent example of your own handiwork—until you drop it—was one of the most interesting and fascinating of subjects. Clay was the base of pottery making, and in the old days when only clay was used, it was a matter of luck as to whether you obtained a good or bad clay—that is to say, a clay that would fire all right or which would crack in the firing. For an average China Clay they could take its composition to be 50 per cent. calcined bone, 25 per cent. stone, and 25 per cent. kaolin or China Clay. The clay made it plastic, the stone made it melt, and the bone was to keep it from melting—which seemed to be a case of contradictions. The measured parts of bone, stone, and kaolin were thrown into a large mixing vat in which, by means of a central shaft fitted with two large beams, the ingredients were mixed into a thick cream with water. The liquid thus obtained was sieved eight times, and then run down a narrow wood channel in which were suspended magnets to remove any small pieces of iron. The liquid, or "slip," was then pumped under pressure into a filter press from which was obtained the clay ready for shaping.

The Firing Process

The shaped clay was now ready to be taken to the biscuit oven, and here the wares were fired. When the oven was full the doorways were sealed and the fires lit. A temperature of 1,200° to 1,300° C. was needed and this was maintained for 52 hours. In a nine-month kiln 17½ tons of coal would be necessary for one firing alone. It would take 15 days for one man to fill the oven, three days to fire, two days for an oven to cool, and nine days for him to empty it.

The ware from this oven was referred to as the biscuit, and this was afterwards glazed. The glaze was a whitish liquid about the same consistency as milk, and was composed of felspar, white lead, stone, and China Clay. The biscuit was now dipped into this glaze and allowed to dry in a warm room, from which it was taken to the glost oven. This was similar in construction to the biscuit oven, but here a temperature of only 1,000° C. was required, and was maintained for only twenty-eight hours. That brought us to the white china ready for the market or for decorating.

Decoration Secrets

In the decoration of modern pottery many of the processes were the secret of individual firms. Special ceramic colours were used. These were obtained as dry powders and were mixed with special oils and turpentine, and could be used similarly as an ordinary oil paint. Upon the ware in the biscuit state a design could be painted by hand and very rich effects could be secured, but the temperature of the glost oven would not allow the more delicate and brighter tints to be used. Printing was a process much used in under-glaze decoration. In the process of over-glaze decoration the colour was placed on the ware after it had come out of the glost oven. The pattern was fixed on the top of the glaze at a bright heat.

China Clay Notes and News

China Clay Compensation Case

At the last St. Austell County Court it was reported that an amount of £150 had been paid into Court by English China Clays, Ltd., in respect of the fatal accident to a young man, Paul Hore, of Foxhole, while in their employment. His Honour Judge Gurdon made an order for the payment of £100 to Mrs. G. Hore, the mother, and £50 to her unmarried daughter.

Patent for Treating Clay

Treating Clay for Pottery, Tiles, etc. No. 16931/25. H. Spurrier, 3,649 Ainslie Ave., Chicago, U.S.A. The air or gas entrapped in clay or like plastic substances for making tiles, pottery, or other ceramic articles, is removed by subjecting the clay to a vacuum and then suddenly breaking the vacuum and restoring a pressure substantially equal to that of the atmosphere.

A Bureau of Mines Appointment

Mr. W. M. Weigel, mineral technologist, has been designated specialist for the division of mineral resources and statistics, Bureau of Mines, on the following subjects: sand and gravel, silica, talc and soapstone, and the fertiliser materials, phosphate rock, potash and nitrates. Mr. Weigel will write the separate chapters of "Mineral Resources of the United States" devoted to these materials.

Unemployment Figures

According to the unemployment returns for Mid and West Cornwall, to July 7, the totals at several towns in the area are gradually decreasing. At St. Austell the decrease is from 311 to 289 and at Fowey from 60 to 58. The totals for Newquay and St. Columb respectively are less by 23 in each case. Other centres in which the figures show decreases are Redruth (15), Camborne (6), Helston (2) and St. Just (12), but unfortunately there are increases at Falmouth of 32, at Hayle of 8, at Penzance of 9, and at Truro of 7.

Russian Kaolin

The Prodasilikat is going this year to commence the construction of a kaolin works in Ukraine, where there are large reserves of kaolin, estimated at 200,000,000 poods, which would keep the establishment at work for a very long time. It is calculated that the cost of production in the new works will come out at 10 to 12 per cent. cheaper than at the old one which is now being exploited. The cost of construction is estimated at 600,000 roubles, of which the Prodasilikat hopes to be able to borrow 250,000 roubles.

China Clay Merchant's Widow's Death

The people of St. Dennis and district have heard with feelings of regret of the death of Mrs. Edna Varcoe, widow of the late Mr. William Varcoe, at the advanced age of 92 years. She died at Eton after an illness of twelve months' duration. Mrs. Varcoe was a very old St. Dennis resident and was held in the highest esteem. Her kindly, genial and hospitable nature won her a large circle of friends. The deceased lady was a most loyal and devoted member of the Church of England and regularly attended early morning communion after she had attained 80 years of age. Deceased was a loyal church worker, prominently identifying herself for many years with church work. Mrs. Varcoe left St. Dennis about ten years ago. Up to that time she was one of the most familiar figures in the place.

Clay Works for £160

At St. Austell last month Messrs. Herbert Rowse and Son, of St. Austell, conducted a sale of a freehold mica clay works, under the Deeds of Arrangement Act, 1914. The works, settling pits, mica and clay dry, the whole of about three-quarters of an acre extent, are situated in Gover Road, St. Austell. The plant consists of drying pan 80 ft. by 90 ft., fitted with travelling bridge and tip wagons, drying capacity from 1,500 to 2,000 tons per annum; tanks 100 and 120 tons capacity. The tanks, settling pits, and micas are well built with concrete, and the dry has concrete foundations with wood pillars and galvanised iron roof. The bidding was commenced at £80 by Mr. Hart Varcoe, and was carried by Mr. W. Wedlake and Mr. Varcoe to £160, at which figure the property was knocked down to the first bidder (Mr. Varcoe), acting on behalf of the purchaser, whose name was not disclosed. Mr. J. Keay, of Messrs. Bournier, Bullock and Co., chartered accountants, of

St. Austell, was the trustee for the property, and the solicitors were Messrs. Stephens, Graham, Wright and Co., St. Austell.

The Translucency of Porcelain

Bulletin No. 154 of the Engineering Experiment Station of the University of Illinois, U.S.A., gives the results of a study of the causes of translucency and the development of an accurate method for the determination of absolute translucencies in porcelain bodies. Some of the conclusions reached as the result of measuring over 400 specimens by means of various methods are as follow: (1) Translucency is not inversely proportional to the thickness of the specimen; (2) the relation between translucency and thickness is not a linear one as was formerly supposed, but an exponential one; (3) in bodies composed of clay, felspar and flint, those with the highest felspar content have the highest translucency and those with the highest clay content the least; (4) increase of burning temperatures gives increase of translucency; (5) fine grinding of bodies gives a very striking increase in translucency at the temperatures used. It was found, however, that variation among individual specimens of the same composition was so large that it was necessary to take the mean results from several specimens in order to obtain trustworthy values of translucency.

Georgia Clays and English Kaolins

An account of some recent tests made by the U.S. Bureau of Mines is of interest in regard to the quality of English China Clays and kindred products. It is stated that while washed Georgia clays can be used in the place of English China Clay in a vitrified dry-press body of small size, such as floor tile, the Georgia clay can be used to displace only a portion of the China Clay (up to about 20 per cent. of the batch) in a porous dry-press body such as a wall tile. However, the extent to which the displacement may safely be carried depends largely upon the shape and size of the ware. The amount of the sedimentary clays that can be used in plastic bodies is much less than in a dry-press body and should probably not exceed 10 to 15 per cent. of the batch. The amount will vary with the ware being manufactured. The proper blending of the clays, together with judicious body mixes, will, it is asserted, render the Georgia clays much more available for white-ware purposes. An increase in flint in bodies containing Georgia clays is essential to obviate crazing of the glaze, to reduce shrinkage, and incidentally to improve whiteness. The colour of ware made from a properly washed clay is said to be about equal to that of ware from the usual grade of China Clay, and only slightly inferior to that of ware from the highest grade of English clay and domestic primary kaolins.

Fowey Resident's National Gift

Through the generosity of Mr. Stanton Covington of Fowey, the National Trust for Places of Historic Interest or Natural Beauty have acquired on behalf of the nation the beautiful headland at St. Saviour's Point, which forms one of the arms of Fowey's magnificent harbour. By his gift to the nation Mr. Covington completes the great natural memorial of the part played by the men of Fowey during the war. It will be remembered that on the cessation of hostilities in 1918 Mr. Covington purchased the summit and southern slopes of the headland known as St. Catherine's Point. This contained between two and three acres of land and a castle of great historic interest, which played a romantic part in the ancient Breton raids, when Fowey was repeatedly attacked by the French marauders. St. Saviour's Point is one of the most beautiful headlands in Cornwall, and the area purchased by Mr. Covington covers about three acres. Probably the land, owing to its magnificent view at St. Catherine's Point and St. Saviour's Point, would have been built on, and the local residents owe Mr. Covington a debt of gratitude for his public-spirited action. The property will be administered and cared for by a special Committee appointed by the National Trust and Fowey Borough Council. The Committee is composed of the following: Mr. Stanton Covington, Sir A. Quiller-Couch, Dr. R. T. Cann, the Mayor of Fowey (Alderman J. G. Lewarne), the Chairman of the General Purposes Committee (Councillor R. Varcoe), and Miss Dove.

Improvements have recently been carried out at St. Catherine's Point by cutting away a lot of undergrowth.

Signor Marconi's Yacht at Fowey

The yacht owned by Signor Marconi arrived at Fowey some days ago, and has since been anchored off the town quay.

Indian China Clay

It is reported from Calcutta that a scheme for exploiting the China Clay resources of Behar is under consideration. It is proposed to manufacture electrical insulators, and the Board of Industries of the province is in favour of State aid.

Unemployed on Relief Works

Mr. E. H. Colcutt (Cornwall County Surveyor) reported at the last meeting of the Highways Committee that the total number of men employed on unemployment relief works on May 31 was 156, 74 being on the St. Austell by-pass road, fair progress with which had been made.

Interesting Fowey Presentation

As a memento Mrs. Treffry, of Place, has been presented by the Mayoress (Miss W. Lewarne) with the silver scissors used by Col. E. Treffry in cutting the tape and declaring the Squire's Field (given to Fowey in memory of his father) opened on May 21, 1926. The case containing the scissors was suitably inscribed.

Par Railwaymen as Income Tax Payers

"I have a friend in the Par neighbourhood whose duty it is to collect Income Tax, and I have heard him state there are few railwaymen in that neighbourhood who do not pay Income Tax," said Mr. J. H. Cossentine, chairman of Liskeard Board of Guardians, when a question arose as to the ability of three railwaymen living at St. Austell, Par and Penzance, to contribute towards assistance for their father, who resides at Liskeard and is in receipt of out-relief.

Clay Merchants' Children in Motor Accident

The daughters of Mr. Henry Stocker and Mr. J. R. Gaved (English China Clays, Ltd.) had narrow escapes from serious injury in a motor accident at St. Austell. Mr. Stocker's chauffeur, Smyth, was driving Mr. Stocker's little daughter and Mr. Gaved's little daughter, who were accompanied by their nurses, Miss Hicks and Miss Cook, in the direction of Pentewan for an afternoon on the sands. The car in which they were being driven was involved in a collision with a motor-cycle, the rider of which, P.C. Stephens, was picked up in a dazed condition badly injured and was removed to the St. Austell Cottage Hospital. Two of the occupants of the car also fared badly, Miss Gaved and a nurse being so badly cut about the face that they too had to be removed to the cottage hospital and have stitches inserted. It was thought at first that P.C. Stephens had received grave injuries to his legs, but subsequent inquiries showed that his chief injury was a crushed right foot. The car was very slightly damaged, but the motor cycle seriously, its front wheel being buckled up.

China Clay Buyer's Unexpected Gift

At a recent luncheon of the St. Austell Rotary Club, when arrangements were being made for the club's annual outing to the St. Austell Poor Law children, Mr. Brian, who was on a visit to St. Austell on China Clay business in connection with his firm, the Paper-makers' Importing Co., of Easton, Pa., U.S.A., and was introduced by Rotarian F. S. Liddicoat, their European representative in St. Austell, welcomed the work the club were doing for children. As a practical demonstration of his interest he donated £10 on behalf of the firm towards the outing they had decided on. He gave an outline of the work being done in Easton among boys, and referred to his own activity in co-operation with the Y.M. in the work. He gave instances of how they set to work in the reformation of boys who had taken the wrong turning for the first time, how they traced the boys' wrongdoing to its origin and took steps to set the boys on the right road, eliminating as far as possible the influences, parental and otherwise, that operated in a contrary direction. Mr. Brian was cordially thanked for his gift and speech.

Tramps' Growing Dislike of Clay District

The statistical report with which Mr. F. H. Smith (Clerk to St. Austell Board of Guardians), who was responsible for the initiation and working out of the County Vagrancy scheme,

has furnished the Cornish Boards of Guardians concerned in it, provides convincing evidence of its success. The basis of the scheme is that the unions pay into a pool one-seventh of a rd. rate on their assessable value, out of which each union is paid at the rate of 9d. per night per tramp relieved and 1s. 6d. if sick. Whatever profit the union makes from the tasks the tramps do while in a particular union is retained as additional revenue by that particular union. The effect of the scheme has been to greatly decrease the numbers of tramps and to enable unions to derive greater benefit from their labour. In Devon tasks are not imposed on the tramps who seek relief, consequently that fair county is "blessed" with the visitations of the gentlemen of the road to a much greater extent than Cornwall is, for they retrace their steps when they reach the Tamar-side, because on this side of the Tamar they have to work for their living.

The total decrease on the year ended March, 1925, was 4,618, the unions participating in it being St. Austell 1,364, Bodmin 1,382, Camelford 614, St. Germans 59, Launceston 424, Stratton 531, and Truro 244. For the half-year ended March this year there was a net decrease of 585. The unions showing decreases were: St. Austell 497, St. Germans 41, Launceston 509, Truro 606, Liskeard 728. Bodmin showed an increase of 206, Camelford 161, and Stratton 172. In the previous half-year Bodmin showed a decrease of 142 and Camelford 81. The greatest deterrent to the tramps (next to tasks) is their having to submit to searching and to their being isolated. St. Austell has shown the greatest consistent decreases since the inauguration of the scheme in 1924, the decreases being most noticeable in the later period, since the establishment of isolated wards, searching, disinfection of clothes, bathing, and other things which the tramps look upon as discomforts.

Clay Owner and Merchant at Social Function

For many weeks the people of the picturesque and ancient China Clay parish of Treverbyn, near Stenalees, have been preparing for the recent luncheon and fancy fair to raise funds for the provision of a memorial to the men who fell in the war, to take the form of a tower to the church and the provision of two vestries, one in memory of the late Rev. J. E. Carey, for 17½ years vicar of Treverbyn. The scheme is estimated to cost £1,200. Up to the date of the effort £350 had been raised.

Mr. Rockingham Gill, of Messrs. Gill and Ivimey, one of the lords of the manor of Treverbyn and a large China Clay landowner, presided at the luncheon. He said he had many recollections of their church and parish, and had known all the vicars of the parish, and particularly the late Rev. Bennett. Since those days and as time had gone on there had been, not in individuals alone, but in the world, an enormous change, and it was only those of them who could recognise that that change had taken place and could blend their minds and ideas and hopes with the effects of that change who could hope to hold their heads above water. One of the things that would be a feature of world history was that England had gone through a social revolution, though none of them knew anything about it. It was sad that after all they had gone through the condition of affairs should be as it was to-day. There could be no success in any community unless each one of them in his own sphere was content to work, and work unceasingly. They all had to work. In any community of individuals, he did not care where it was situated, a "place for heroes" could only be prepared by hard work and labour. All of them, in their various spheres, were parts of a machine—they were cog-wheels in that machine, and if any of the cogs did not fit the whole machine was upset.

Mr. Samuel J. Dyer, a prominent China Clay merchant interested in several companies, in proposing a vote of thanks to Miss Williams, said that they were passing through a critical time in the coal trade and in the China Clay industry as well. Mr. Dyer referred to Mr. J. C. Williams's able chairmanship of the recent China Clay conference, and said he would like to see that day come when they could all get together in the right spirit. Mr. Williams brought them together in the right spirit, and if that spirit prevailed they would have a successful China Clay industry. They were having a very bad time, but he hoped and trusted that that terrible cloud would soon depart and that peace and understanding would prevail.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Charlestown Shipping—June, 1926

Date.	Arrivals Vessel.	From
June 1.....	<i>Ardenle</i>	Cardiff
June 6.....	<i>Scotia</i>	Littlehampton
June 9.....	<i>Devonia</i>	Barry
June 10.....	<i>Katie</i>	Par
June 11.....	<i>Jeanne</i>	Truro
June 14.....	<i>Karnten</i>	Exmouth
June 14.....	<i>Tamnamore</i>	Cardiff
June 24.....	<i>Brando</i>	Cowes
June 25.....	<i>Harvest King</i>	Plymouth
June 27.....	<i>Walkyrie</i>	Quimper (France)
June 27.....	<i>La Revanche</i>	Nantes
June 30.....	<i>Romanie</i>	Par

Date.	Sailings Vessel.	*Destination.
June 1.....	<i>Marta</i>	Brussels
June 3.....	<i>C. and F. Nurse</i>	London
June 7.....	<i>Ardenle</i>	Calais
June 8.....	<i>Pet</i>	London
June 12.....	<i>Jeanne</i>	La Pallice
June 15.....	<i>Karnten</i>	Terneuzen
June 17.....	<i>Tamnamore</i>	Larne
June 23.....	<i>Devonia</i>	London
June 28.....	<i>Brando</i>	Raumo
June 30.....	<i>Walkyrie</i>	Aberdeen
June 30.....	<i>La Revanche</i>	Nantes

Fowey Shipping—June, 1926

Arrived.	Name.	Sailed.	Destination.
June 1, S.S. <i>Gouwestroom</i>		June 12, Amsterdam	
June 1, S.S. <i>Wearbridge</i>		June 22, Newport News	
June 1, M.V. <i>Shamrock</i>		June 2, Plymouth	
June 1, <i>Lichstrall</i>		June 14, Hamburg	
June 1, M.V. <i>Lydia Cardell</i>		June 11, Rouen	
June 1, S.S. <i>Signfred</i>		June 11, Sodertelje	
June 2, S.S. <i>Gronant Rose</i>		June 11, Preston	
June 3, S.S. <i>Calcaria</i>		June 4, Dieppe	
June 3, S.S. <i>Matthias</i>		June 9, Rotterdam	
June 4, M.V. <i>Schwalbe</i>		June 10, Copenhagen	
June 4, S.S. <i>Mersey</i>		June 15, Manchester	
June 4, <i>W. E. Gladstone</i>		June 8, Looe	
June 4, <i>Pedestrian</i>		June 8, Pentewan	
June 5, <i>Scotia</i>		June 6, Charlestown	
June 5, M.V. <i>William and John</i>		June 6, Plymouth	
June 5, S.S. <i>Nestle</i>		June 25, Portland, Me.	
June 5, M.V. <i>Monsun</i>		June 12, Skien	
June 6, S.S. <i>Pansy</i>		June 12, Ridham	
June 6, <i>Mars</i>		June 23, Copenhagen	
June 7, S.S. <i>Joffre Rose</i>		June 8, Boston, Lincs	
June 7, S.S. <i>Ferndene</i>		June 12, Pasages and Bilbao	
June 7, S.S. <i>Eastlea</i>		July 2, Philadelphia	
June 8, S.S. <i>Taransay</i>		* Philadelphia	
June 8, S.S. <i>Tecco</i>		June 12, Seville	
June 9, M.V. <i>Hope</i>		June 14, Plymouth	
June 10, S.S. <i>Dorrien Rose</i>		June 12, Dublin	
June 12, S.S. <i>Hayle</i>		June 19, Ridham	
June 12, S.S. <i>Hornby Castle</i>		* Philadelphia	
June 12, M.V. <i>Raymonde Naval</i>		June 16, Harburg	
June 12, M.V. <i>Tarragona</i>		June 19, Rochester	
June 12, S.S. <i>Vechtstroom</i>		June 16, Amsterdam	
June 13, S.S. <i>Guelder Rose</i>		June 17, Runcorn	
June 14, S.S. <i>Adour</i>		June 23, Antwerp	
June 14, <i>Rose</i>		June 15, Par	
June 15, S.S. <i>Elloughton</i>		June 17, Bo'ness	
June 15, <i>Mouette</i>		June 30, Gravelines	
June 15, S.S. <i>Borg</i>		June 22, Antwerp	
June 15, S.S. <i>Dragoon</i>		June 21, Birkenhead	
June 18, M.V. <i>Frida Both</i>		June 24, Harburg	
June 18, S.S. <i>Dorrien Rose</i>		June 23, Preston	
June 18, S.S. <i>Joffre Rose</i>		June 23, Preston	
June 19, S.S. <i>Hubbastone</i>		June 22, Brussels	
June 19, S.S. <i>Skoger</i>		June 24, Aberdeen	
June 19, S.S. <i>Bostonfincs</i>		June 25, Rotterdam	
June 19, S.S. <i>Clodoald</i>		June 25, Rouen	
June 19, S.S. <i>Fairland</i>		June 26, Liverpool	
June 19, S.S. <i>Pansy</i>		June 26, Zeebrugge	
June 20, S.S. <i>Gronant Rose</i>		June 28, Preston	

June 20, S.S. <i>Cisneros</i>	June 24, Genoa
June 21, S.S. <i>Sambre</i>	June 29, Antwerp
June 22, M.V. <i>Mayblossom</i>	June 24, Plymouth
June 23, M.V. <i>Guthorm Alsaker</i>	July 1, Drammen
June 24, M.V. <i>Anna Kirstine</i>	July 1, Seville
June 24, M.V. <i>St. Francois de Salles</i>	June 30, St. Malo
June 25, S.S. <i>Damsterdiep</i>	* Rouen
June 25, S.S. <i>Matthias</i>	June 30, Rouen
June 25, S.S. <i>Mersey</i>	June 30, Weston Point
June 25, M.V. <i>Shamrock</i>	June 29, Plymouth
June 25, S.S. <i>Dunmore</i>	June 28, Plymouth
June 26, S.S. <i>Neotsfield</i>	* Baltimore
June 26, S.S. <i>Blush Rose</i>	June 27, Hayle
June 27, S.S. <i>Horn</i>	July 1, Pasages
June 27, S.S. <i>Gouwestroom</i>	* Amsterdam
June 27, S.S. <i>Tynan</i>	July 2, Larne
June 27, S.S. <i>Stella</i>	* Kotka
June 27, S.S. <i>Afon Dyfi</i>	* Brussels
June 28, M.V. <i>Lynher</i>	June 29, Plymouth
June 28, S.S. <i>Dorset Coast</i>	June 29, Liverpool
June 28, S.S. <i>Bonawe</i>	* Antwerp
June 30, M.V. <i>Hope</i>	July 1, Plymouth
June 30, M.V. <i>Zeehond</i>	Northfleet
June 30, S.S. <i>Ernrix</i>	* Grimsby

* In port.

Par Harbour Shipping—June, 1926

Date.	Sailings Vessel.	Destination.
June 1, M.V. <i>Lydia Cardell</i>		Fowey
June 2, S.S. <i>Magrix</i>		Greenhithe
June 2, S.V. <i>Alf Everard</i>		Rochester
June 7, M.V. <i>Isabel</i>		Plymouth
June 8, M.V. <i>Hetty</i>		Penarth
June 9, M.V. <i>Hope</i>		Fowey
June 11, S.V. <i>Alice Williams</i>		Runcorn
June 11, M.V. <i>Pamela Hope</i>		London
June 11, M.V. <i>Katie</i>		Charlestown
June 12, M.V. <i>Cornelia</i>		Antwerp
June 12, S.S. <i>Munkfors</i>		Christiansand
June 13, S.V. <i>Guiding Star</i>		London
June 14, S.V. <i>S. F. Pearce</i>		Gravesend
June 14, S.S. <i>Moorside</i>		Boulogne
June 15, S.S. <i>Tanny</i>		Bristol
June 16, S.S. <i>Greta</i>		Frederikshall
June 17, M.V. <i>Hope</i>		Looe
June 21, S.V. <i>Eve</i>		Plymouth
June 22, S.V. <i>Ivy</i>		Queenborough
June 23, S.S. <i>Norrix</i>		Newcastle
June 24, S.V. <i>Pedestrian</i>		London
June 24, S.S. <i>Teifi</i>		Terneuzen
June 24, S.S. <i>Homedale</i>		Jersey
June 25, M.V. <i>Hope</i>		Plymouth
June 25, M.V. <i>Ilse</i>		Leith
June 26, M.V. <i>Queen Philippa</i>		Rochester
June 27, S.V. <i>Henrietta</i>		London
June 28, S.V. <i>Rose</i>		Gravesend
June 28, S.V. <i>Alf Everard</i>		Pentewan
June 29, S.S. <i>Bonawe</i>		Fowey
June 30, M.V. <i>Romanie</i>		Charlestown
June 30, S.S. <i>Dunmore</i>		Terneuzen
June 30, S.S. <i>Coombe Dingle</i>		Bristol

Date.	Arrivals Vessel.	From
June 3, S.V. <i>Alice Williams</i>		Mevagissey
June 4, S.V. <i>S. F. Pearce</i>		Exmouth
June 6, M.V. <i>Cornelia</i>		Littlehampton
June 6, M.V. <i>Pamela Hope</i>		Southampton
June 6, M.V. <i>Hetty</i>		Truro
June 7, M.V. <i>Hope</i>		Plymouth
June 7, S.V. <i>Guiding Star</i>		Hayle
June 7, M.V. <i>Katie</i>		London
June 8, S.V. <i>Henrietta</i>		Mevagissey
June 11, S.S. <i>Munkfors</i>		Truro
June 12, S.S. <i>Moorside</i>		Plymouth
June 13, S.V. <i>Pedestrian</i>		Pentewan
June 14, S.V. <i>Rose</i>		Fowey
June 14, S.V. <i>Ivy</i>		Porthoustock
June 15, S.S. <i>Greta</i>		Bridport
June 15, S.S. <i>Tanny</i>		Hayle
June 16, M.V. <i>Hope</i>		Plymouth
June 17, S.V. <i>Eve</i>		Porthoustock
June 18, M.V. <i>Hope</i>		Looe

Date.	Vessel.	From
June 19, M.V. <i>Hope</i>		Porthoustock
June 20, S.S. <i>Teifi</i>		Ostend
June 21, S.S. <i>Homedale</i>		Ostend
June 22, S.S. <i>Norrix</i>		Devonport
June 23, M.V. <i>Queen Philippa</i>		Plymouth
June 23, S.V. <i>Etincelle</i>		Charlestown
June 23, M.V. <i>Ilse</i>		Duranez
June 24, S.V. <i>Alf Everard</i>		Rochester
June 24, S.S. <i>Annchen Peters</i>		Carlstad
June 25, M.V. <i>Romanie</i>		Brussels
June 27, S.V. <i>Mary Ann Mandell</i>		London
June 27, M.V. <i>Karnten</i>		Terneuzen
June 27, S.S. <i>Bonawe</i>		Glasgow
June 28, M.V. <i>Welcome</i>		Penryn
June 29, S.S. <i>Dunmore</i>		Fowey
June 30, S.S. <i>Coombe Dingle</i>		Jersey
June 30, S.V. <i>Valonia</i>		Plymouth
June 30, M.V. <i>Regina</i>		Plymouth

Par Harbour Tide Table, August, 1926

(British Summer Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Sunday	1	11.40	—	11.0
Monday	2	0.7	0.38	10.5
Tuesday	3	1.14	1.53	10.3
Wednesday	4	2.31	3.7	10.5
Thursday	5	3.42	4.15	10.10
Friday	6	4.46	5.14	11.4
Saturday	7	5.39	6.1	11.9
Sunday	8	6.22	6.42	12.0
Monday	9	7.1	7.18	12.1
Tuesday	10	7.34	7.50	12.3
Wednesday	11	8.5	8.20	12.2
Thursday	12	8.35	8.50	12.1
Friday	13	9.5	9.20	11.10
Saturday	14	9.36	9.52	11.6
Sunday	15	10.9	10.27	11.0
Monday	16	10.47	11.9	10.6
Tuesday	17	11.34	—	10.0
Wednesday	18	0.2	0.35	9.9
Thursday	19	1.13	1.55	9.11
Friday	20	2.38	3.18	10.8
Saturday	21	3.55	4.28	11.8
Sunday	22	4.58	5.26	12.8
Monday	23	5.53	6.19	13.6
Tuesday	24	6.44	7.8	13.10
Wednesday	25	7.31	7.53	14.2
Thursday	26	8.15	8.37	14.1

E. CLEMENS, Harbour Master.

May Deliveries Doubled

June Total Nearly Touches 93,000 Tons

PARTLY due to the efforts made to overtake the loss in shipments through the general strike and partly to the taking in of big stocks on the part of buyers lest the prolongation of the coal strike should contract supplies, June shipments of China Clay, China Stone and ball clay reached the record total of 92,909, made up of 88,820 tons China Clay, 2,988 tons China Stone, and 1,101 tons ball clay. With this bumper total, the difference between the total shipments for the six months this year compared with the corresponding period last year has been reduced to 8,676 tons. Details:

Port.	China Clay. 1926.	China Clay. 1925.	China Stone. 1926.	China Stone. 1925.	Ball Clay. 1926.	Ball Clay. 1925.	Total. 1926.	Total. 1925.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Fowey ..	74,532	56,019	2,779	3,004	1,101	2,1619	78,412	61,642
Charlestown ..	2,741	3,271	—	—	—	—	2,741	3,271
Par ..	4,792	2,327	209	826	—	—	5,001	3,153
Penzance ..	3,177	—	—	—	—	—	3,177	—
Plymouth ..	857	2,950	—	—	—	—	857	2,950
Falmouth ..	106	200	—	—	—	—	106	200
By rail ..	2,615	4,255	—	—	—	—	2,615	4,255
June ..	88,820	69,022	2,988	3,830	1,101	2,619	92,909	75,471
Total, 5 mths	350,749	377,177	16,558	15,952	9,021	8,462	375,427	401,591
Total, 6 mths	439,569	446,199	19,546	19,782	10,122	11,081	468,386	477,061

China Clay Imports for June, 1926

A RETURN of the registered imports of China Clay (including China Stone) into Great Britain and Northern Ireland from the several countries of consignment during the month of June, indicates that 380 tons, value £1,140, were imported from Italy, and two tons, value £10, from America, the total being 382 tons, value £1,150.

China Clay Exports for June, 1926

RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom, from the United Kingdom to each country of destination registered during the month ended June 30, 1926:

COUNTRY OF DESTINATION.	CHINA CLAY. QUANTITY. VALUE.
	Tons. £
Finland	81 162
Estonia	923 1,154
Latvia	1,090 2,443
Sweden	2,197 3,841
Norway	1,693 2,605
Denmark	167 645
Germany	2,430 5,406
Netherlands	5,417 11,197
Dutch Guiana	105 395
Belgium	6,043 9,773
France	2,201 4,321
French Possessions in the Pacific	243 243
Portugal	109 301
Spain	1,439 4,099
Italy	848 2,544
Roumania	5 23
China	15 77
Japan	53 340
United States of America	32,714 66,988
Mexico	70 267
Nigeria	— 2
Cape of Good Hope	— 3
Natal	1 9
Bombay, via Other Ports	2,022 8,683
Madras	30 150
Bengal	505 1,725
Australia	35 174
New Zealand	1 4
Canada	161 531
Newfoundland	3,322 4,397
Irish Free State	4 28
Total	63,924 132,530

The corresponding figures for May were 54,377 tons, value £112,442. The corresponding figures for June, 1925, were 61,362 tons, value £125,518.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette, &c.

Companies Winding Up Voluntarily

BRITISH POTTERY, LTD. E. E. Meugens, 18, Bennett's Hill, Birmingham, Chartered Accountant, appointed liquidator, June 21.

LITTLETHORPE POTTERIES, LTD. By special resolution (June 11), confirmed June 28.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

BOWATER'S PAPER MILLS, LTD., Northfleet. Reg. June 17 (by order on terms), £25,000 and £25,000 charges, to W. V. Bowater and Sons (1926), Ltd., 159, Queen Victoria Street, E.C., paper merchants, and C. Walmsley and Co., Ltd., Bury, engineers; general charge. *£300,000. January 6, 1926.

JACKSON'S MILL-BOARD AND PAPER CO., LTD., London, E.C. Reg. June 2, £20,000 1st debts. (filed under sec. 93 (3) of the Companies (Consolidation) Act, 1908), present issue, £15,300; general charge. *£8,350 debts. July 15, 1925.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests.
Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., Bouverie House, 154, Fleet Street, E.C.4. All communications relating to Advertisements, Subscriptions, etc., should be sent to the Manager, "The China Clay Trade Review," at this address. Telegrams—"Allangas, Fleet, London." Telephone—City 0244 (10 lines)

China Clay Producers' Meeting

OUR special correspondent informs us by wire that the meeting of the China Clay producers, held on Wednesday, from which important results were expected, was private, and that at the moment no information was available. The following notes, written before the meeting occurred, give some idea of the position of affairs as it was then.

China Clay Organisation

We write on the eve of another important meeting of the China Clay producers of Cornwall and Devon at which a final decision is being taken on the question of the formation of an all-in association, which has been the subject of consideration and negotiation by the outside producers (medium and common clays) and the Best Clays Association, which has operated since the last open association broke up in the autumn of 1924. It will be recalled that as we were going to press last month a meeting was to be held, the notices of which held out very little hope of the project being brought to fruition. As we anticipated, wiser counsels prevailed at the meeting, over which the Lord-Lieutenant of Cornwall (Mr. J. C. Williams) presided, and it was decided to make a further attempt to overcome the difficulties with which the executive committee were confronted.

Existing Association's Help

The executive committee of the proposed All-in China Clay Association subsequently met the Board of the Best Clays Association, when the fresh promise of fruitful results gave new hope to those who are looking to the project for the salvation of the industry. The accommodating attitude which it is stated the Best Clays Association adopted towards the deputation, who sought their assistance in helping to ease the deadlock, has given particular satisfaction to the "outsiders." The further respite granted, and the offer to use their best endeavours to assist the executive in their task of reconciling conflicting interests, enhanced the favourable impression created by the attitude of the Best Clays' Association towards the "all-in" Association scheme.

Following the meeting, the executive issued to the trade an optimistic report which contained the following significant passages: "It is felt that subject to the settlement of one or two minor matters with certain producers, there is sufficient representation of the trade to justify the immediate formation of the association which has been proposed. It is almost unanimously agreed by the producers who are willing to join the association, that the quantity of the various qualities of clay that will be controlled by the association will be sufficient to ensure that its members shall not suffer from external competition.

Outline of Policy

"It is intended that the knowledge and experience gained since the break-up of the last association shall be used to the fullest extent, that the prices of clay shall be fixed in line with market valuation, that producers shall have a fair chance of shipping their due proportion of the trade, and that every step which the general common sense of the trade shall decide is necessary to be taken in the interest of the trade shall be taken, and that minor

and unimportant matters shall not be allowed to interfere with the best interests of the industry."

We are able to supplement this statement with a few more details of how this welcome change was brought about by the timely intervention of Mr. F. R. Lovering of the firm of John Lovering and Co., who, with other members of the board of China Clay Producers, Ltd. (Best Clays' Association) recognised the persistency and assiduity with which the executive committee had pursued its difficult task under the chairmanship of Mr. E. J. Hancock, with Mr. A. J. Perry as secretary, and Mr. J. Hoyle as one of the most active members.

Mr. F. R. Lovering's Timely Intervention

Their determination greatly impressed the board of the Best Clays Association, who have all along had the will to assist, but were somewhat restricted in their capacity to do so by the formula they originally fixed as the basis on which they were prepared to co-operate with the outsiders. Unless some departure from that formula could be found, the position looked hopeless when the executive committee came to wait upon the board of the Best Clays Association with their report on the deadlock. Then Mr. F. R. Lovering, one of the partners of the important firm of John Lovering and Co., brought forward his scheme for solving the difficulty. This scheme met with the approval of Mr. Lovering's colleagues on the Best Clays Association, was laid before the executive of the proposed All-in Association, and was the means of helping the executive to overcome the deadlock that had faced them.

We understand that the lines on which the promoters of the scheme are proceeding are such that the proposed association will be made as impregnable against insidious attack as is humanly possible in the interests of the industry as a whole, with regard to the individual interests of the members comprising it. With the adoption at the outset of a spirit of give and take by all the producers, the power of an association such as that contemplated should be incalculable as a factor in the restoration of the prosperity of the industry for the benefit of China Clay proprietors, landowners, shareholders, and workers.

Coal Strike Effects

The prolongation of the coal strike is having a serious effect upon the China Clay industry, as apart from the necessity of having to buy foreign coal at exorbitant prices, the results achieved from a ton of foreign coal are not comparable with those obtained from a ton of the class of British coal normally used in clay drying. Seeing that coal costs are, next to labour, the highest in the production of China Clay, there must be an increase in the price of all grades of clay if the producers are to recoup themselves for the heavy extra costs they are having to incur. The China Clay producers cannot be expected to shoulder the whole of the burden of increased coal costs, though up to now the prices of clays, especially those in the common grades, have not been advanced to anything like an extent commensurate with the increased cost of production. Therefore, apart from the formation of an association, there must be an upward trend in the prices of China Clay for some time to recoup producers for their heavier production costs.

British China Clay: Competition in World Markets

What Foreign Statistics Reveal

We publish below an exclusive survey, prepared in our Statistical Department, of the present position in the world markets for China Clay, with special reference to the position and prospects of the British China Clay industry.

CHINA Clay shipments rank as one of the most progressive activities in the whole of British export trade. During the first six months of this year, for instance, exports of China Clay have been right up to the high standard established during the same period of last year and this notwithstanding the difficulties inflicted upon export business by the industrial upheaval of the current year. If normal conditions had prevailed throughout the past few months it is quite certain that the expansion over last year's total at this date would have been even more marked than the succession of increases which have characterised the totals of preceding years.

There is an upward trend of business going on all the time as the result of insatiable and developing world demands. Take as the starting point for comparison the figures recorded for three years ago when total shipments of China Clay stood at 522,760 tons. Not only was this same volume of business maintained in the succeeding twelve months of 1924, but in addition a further weight of 91,440 tons was shipped, representing increased trade of 18 per cent. This was still further enlarged in 1925 by 38,380 tons, so that the net increase between the years 1923 and 1925 has amounted to not less than 25 per cent. An industry which can show such a rate of progress is obviously a competing force of world-wide significance, and the possibility is suggested that a few years more will see a doubled export trade. What in actual fact this competing strength amounts to in overseas markets is to be seen in numbers of statistics which have been collected and analysed in respect of the main purchasing countries throughout the world. These reveal points of really live importance to British clay producers and exporters, since not only do they show in an indisputable manner the value which customers abroad attach to the British commodity but they also indicate the attitude of these customers to our rival suppliers, and, moreover, serve to show where the chief buying developments are occurring.

The Market in U.S.A.

First in importance of all China Clay markets is the United States. This occupies a very signal position for at least three noteworthy reasons. Firstly, it is a market which has shown an uninterrupted series of expanding purchases for years past; secondly, it buys as much China Clay from Great Britain as all our other markets throughout the world taken together; and finally, British producers have here a virtual monopoly in what constitutes the most valuable market of the moment. Official statistics of the United States contained in the U.S.A. Summary of Foreign Commerce bring out clearly all these points, and show the position in recent times. In 1923 this market imported from all sources of supply, including ourselves, as much as 312,000 tons, in 1924 the total had risen to 315,437 tons, and last year the figure rose further to 322,623 tons. Over these three years the proportions of the total British clay export trade which have gone solely to U.S.A. have been 56 per cent. in 1923, 55 per cent. in 1924 and 52 per cent. in 1925, whilst in the first half of the current year 56 per cent. of our total shipments went to this market. These proportions have thus been fairly constant, although, as already shown, growing volumes of our export trade as a whole are recorded. In other words, the United States is increasing its buying of British clay as fast as that of all other markets.

As regards the position of competitors it is illuminating to turn to the latest complete American statistics which deal with the year 1924 but are typical of other years. In that period, out of total U.S.A. demands amounting to 315,437 tons, there are recorded 2,232 tons as coming into the market via Canada, as well as a negligible item of 301 tons from all the other supplying sources of Europe, but the whole of the remaining shipments of not less than 312,800 tons were consigned from Great Britain. The value of this business is high, the Americans themselves placing it at 3,190,000 dollars, and an important fact which emerges from the consideration of these figures is that in the face of growing American demands British producers are not only maintaining a strong position but are taking much of the increase and are therefore actually

gaining on competitors. To appreciate the position right up to date it is only necessary to refer to the table set out on the opposite page, where British shipments to the United States are recorded at 177,000 tons, and as this relates to the first six months of the current year the indications are that 1926 will bid fair to set up a "record."

Our Competitors in European Trade

Outside U.S.A. there is a keener competition to be faced, and particularly is this so on the Continent of Europe, where localised sources of supply are active. Nevertheless, the British proportion of trade is well established, and although the Continent as a whole takes less from us than does the United States, yet 40 per cent. of our total exports go to these Continental markets and are distributed over twenty different countries. The outstanding import trade in this direction in order of present importance is offered by Belgium, Holland, France, Italy, and Germany. During the past six months Belgium has received more than 32,000 tons from this country, a very satisfactory total when compared with the 52,000 tons of China Clay shipped by us during twelve months of 1925. These figures represent the major proportion of the Belgian import trade, other requirements of this market being taken from home resources.

Another useful continental connection is Italy, and this provides a fine example of a market which we have always supplied with good quantities and one which is now ripe for a much expanded business. Italian official statistics taken from the *Movimento Commerciale* show that last year the purchases of British China Clay were 32,000 tons, whereas in the year before the war these particular consignments were 24,215 tons; and corresponding with these facts may be placed the total imports from all sources which were last year 36,000 tons as against the 1913 total of 28,240 tons. Obviously this market is developing to great purpose and at the same time our share of it is increasing, so that our supreme position is little assailed by such competition as is presented by German and Czecho-Slovakian supplies.

The Position in France

In France a slightly different position prevails, since much wider competition is experienced, but as yet the net total of this is not of great consequence and British supplies are the dominant factor in the import trade. From the official *Statistique du Commerce Extérieur* it is apparent that the competing sources are Germany, Czecho-Slovakia, Luxembourg, Belgium, and the French possessions in Northern Africa, and that of these the Luxembourg-Belgian area is the source which merits the closest attention, as besides furnishing the largest competitive supplies it has also increased its quota since the war at the expense of British producers. Nevertheless, the fundamental point remains that our supplies are still more than double those of all competitors combined. In 1913 France imported 640,000 quintals (58,200 tons) of China Clay of which 553,000 quintals (50,300 tons) came from Great Britain, 41,675 quintals (3,800 tons) from Germany and 30,600 quintals (2,800 tons) from Belgium. French figures for last year are not yet analysed in detail, and the import total of 576,000 quintals, being somewhat lower than normal, vitiates comparison, but the 1924 results of 658,400 quintals compare with the pre-war total and show that whilst the Belgian figure has expanded by 118,000 quintals and has absorbed 20,000 quintals of the former German trade, there is a considerable decline of nearly 100,000 quintals in British supplies and this has also accrued to our competitor. The French requirements thus seem to call for more enterprise on the part of British producers as in the matter of transport costs to this market we suffer less disadvantage than in the case of most of our other overseas markets.

Demand in Germany and Switzerland

Turning from these countries where the British commodity looms so large it is well to realise where the contrary position exists, and a case in point here is Germany. According to the German *Statistisches Jahrbuch*, the bulk of imports into this

market are coming from Czecho-Slovakia, and compared with the total taken from this competitor our own supplies look very small. This has not always been so, and before the war it was the British shipments which were the main feature. In 1913 Germany imported in all 274,000 tons of China Clay of which 108,000 tons came from Great Britain, but by 1923 the British business had declined to less than 8,000 tons and Czecho-Slovakia had entered with nearly 90,000 tons. This made the total German imports up to close on 100,000 tons, a very much reduced figure as compared with that of ten years earlier. In 1924 the German market began to show signs of recovery, with total imports up to 146,000 tons, and although as part of the increase British supplies had doubled, the Czecho-Slovakian supplies also grew and gave this competitor a business of 120,000 tons.

Incidentally, Germany is also an export country for China

Clay, and supplies small quantities to such bordering States as Denmark, Holland, Switzerland, and Poland. In all, this export trade does not exceed 20,000 tons, or only about half its pre-war extent, but though relatively small in the aggregate it wields an extremely effective influence in one European market, viz., Switzerland, which is Germany's largest customer, just as it is one of our poorest trade connections. This last point is definitely confirmed by the Swiss *Statistik des Warenverkehrs*, wherein is demonstrated that half of the Swiss requirements are being obtained from Germany, about another quarter from Czecho-Slovakia, and only one-eleventh part from Great Britain.

The other outstanding China Clay market is India, which is easily the largest of our Empire customers and absorbs practically 75 per cent. of what may be termed our Empire export trade. Figures dealing with this area are discussed elsewhere.

China Clay Exports

A Survey of the First Half of 1926

WE are able to give below completed totals of British China Clay exports down to the end of the first six months of this year, which have been compiled from our own exclusive monthly figures of this trade, showing the quantities and values of consignments to each individual market. These are set out in geographical order commencing with the countries of Europe, followed in turn by the foreign countries of America, the foreign countries of the Far East, and finally the group of British Empire countries throughout the world. Side by side with the figures of 1926 are placed, for comparative purposes, the similar results of similar periods in immediately preceding years, and in a general survey of the trading position one or two striking features are worth noting.

Overseas trade in China Clay has on the whole been better this year than in either 1925 or 1924, and judged on the basis of total tonnage exported, the 317,158 tons recorded for 1926 represent an increase of 3,300 tons over last year and 4,260

tons more than two years ago. Present prices are, however, much below those of the preceding periods, and this is reflected in the comparison of total values which shows the £657,228 of 1926 as being below both 1925 and 1924, although associated with the largest quantity. The more satisfactory way, therefore, to measure trading volumes throughout the table is to confine observations to quantities exported.

Under the broad heading of exports to foreign countries, the latest total stands at 300,415 tons, and this has shown very little fluctuation over the three years. With Empire countries there is, however, discernible an upward trend since 1924 which has been sufficiently strong in character to influence favourably the whole of our export trade.

In the figures given below under 1924, figures for Latvia comprise also those for Russia and Esthonia, figures for Canada comprise also those for Newfoundland, and figures for New Zealand comprise also those for South Africa.

	1926.		1925.		1924.	
	First Six Months.		First Six Months.		First Six Months.	
	Quantity,	Value,	Quantity,	Value,	Quantity,	Value,
	Tons.	£	Tons.	£	Tons.	£
To FOREIGN COUNTRIES :						
Finland	1,907	2,384	4,005	7,132	2,609	4,794
Esthonia	1,335	1,580	851	800	—	—
Latvia	1,664	3,158	450	759	1,743	3,566
Russia	240	400	105	552	—	—
Sweden	8,294	16,566	7,275	15,547	6,707	16,655
Norway	8,977	12,885	11,147	14,587	5,009	9,420
Denmark	1,190	3,344	1,264	3,180	1,737	4,907
Germany	10,247	23,183	14,322	34,209	7,068	18,905
Holland	20,241	41,743	17,599	34,702	17,304	42,674
Belgium	32,002	51,371	27,185	47,143	28,236	58,664
France	16,590	29,727	18,955	34,130	19,770	42,965
Portugal	250	634	—	—	5	21
Spain	8,062	19,872	5,757	14,797	9,268	25,965
Italy	10,690	27,368	14,879	35,436	12,071	33,061
Rest of Europe	75	348	105	447	871	3,173
U.S.A.	177,048	360,251	176,046	363,010	184,085	440,529
Mexico	722	2,932	427	1,712	463	2,056
Argentina	115	484	269	1,457	426	1,969
Rest of South America	329	1,278	49	249	530	2,312
China	36	195	—	—	47	150
Japan	53	340	—	—	2	7
Dutch East Indies	105	395	401	1,519	—	—
French Pacific	243	243	—	—	—	—
Total	300,415	600,681	301,091	611,377	297,951	711,793
To EMPIRE COUNTRIES :						
India	12,743	49,736	11,482	47,528	9,941	39,240
Australia	242	1,268	252	1,280	217	981
Canada	421	1,064	656	1,730	3,778	7,398
Newfoundland	3,322	4,397	377	407	—	—
New Zealand	13	50	—	—	1,010	2,098
South Africa	2	32	1	19	—	—
Total	16,743	56,547	12,768	50,964	14,946	49,717
Total Overseas Trade	317,158	657,228	313,859	662,341	312,897	761,510

Cornwall Royal Geological Society Visit to St. Austell China Clay Works

THE Royal Geological Society of Cornwall last month held a very successful outing to the China Clay area and Caerhayes Castle, and members attended to the number of about sixty. The party was led by the president, Mr. F. S. Stephens, of Camborne.

The party started from St. John's Hall, Penzance, and proceeded *via* St. Erth station and Hayle, Camborne, Redruth, Chacewater and Probus to St. Stephens. A brief address was given by the president at Tresillian. At St. Stephens the party visited the Tregargus China Stone Quarry and the method of quarrying and crushing the stone was explained. Mr. J. M. Coon, of St. Austell, who is well known for his valuable geological and mineralogical work in the district, proved a very able conductor in the China Clay area, and at Tregargus he gave an address on the China Stone area and the characteristic minerals. Mr. E. H. Davison remarked that, generally speaking, they could not find two geologists who agreed to the origin of things, but in this particular case he entirely agreed with the explanation Mr. Coon gave of the China Stone's probable origin.

Origin of China Clay Hydraulics

After lunch at St. Stephens the party proceeded to the Blackpool China Clay works of Parkyn and Peters, situated near St. Mewan Beacon, and the pit was inspected from a point of vantage. Various interesting details in the working of the mine were given, and the men were seen working in the pit "bottoms." The members of the party were keenly interested in the method of washing out the clay by means of strong hoses, and it was explained by Mr. Coon that many years ago the West of England China Clay Co. (now English China Clays, Ltd.) installed a Merrivale steam engine and commenced washing hydraulically, but found the process a failure because the steaming was much coarser than if done by men with shovels. It was not until 45 or 50 years had elapsed that the hydraulic process was adopted generally, but nowadays they had to forfeit fineness of washing in order to produce the quantities of clay.

Questions were asked by members of the party as to the use of China Clay sand for concrete block making, and it was pointed out that the sand, if properly chosen, made an excellent block. One gentleman stated that he thought of having a house built with concrete blocks, but on putting a block in water it had crumbled away and was held in suspension in the water as a white liquid, so he had finally used bricks. Mr. Coon explained that the sand used for the block must have been too fine and contained soft clay substance, because blocks made in the district with a certain sand had proved harder than stone. One or two others present thought that the making of concrete blocks with the waste China Clay sand could be made a much bigger business in the district, as concrete blocks made very cheap material for building.

Topaz as Common Stone

After an inspection of a pumping machine, settling tanks and micas, a halt was made at St. Mewan Beacon, which, Mr. Coon explained, was a minor outcrop composed of topaz, which differed from other rocks of the district. Stone from St. Mewan Beacon had been formerly taken to the Tregargus Stone Quarry for use in the crusher beds owing to its hardness, but since the discovery of hard blue stone close to the mills they had not needed to come to the beacon. It was only recently that he (Mr. Coon) had discovered what St. Mewan outcrop was composed of, and that it was wrongly described in the Cornish geological books. Members were rather surprised at finding topaz to be such an ordinary looking stone when many of them had imagined it as a beautiful jewel.

From the beacon the party proceeded to Caerhayes, passing the Kingsdown Tin Mine on the way. At the castle the visitors were cordially received by Mr. J. C. Williams, the Lord-Lieutenant of the county, and entertained to tea. At the close the president, Mr. F. S. Stephens, said they would all agree that they owed a debt of gratitude to their secretary, Mr. Davison, who year by year arranged a most delightful programme of excursions. He thought he would be at liberty to announce at that juncture that the Lord-Lieutenant would succeed him as president of the society after next November.

St. Stephens Lady's Will Dispute Living from Clay Shares

At the last St. Austell County Court His Honour Judge Gurdon was engaged for three hours in unravelling a question of the ownership of two leasehold houses of the value of £500 at Nanpean, raised by the executors under the will of Mrs. Kezia Varcoe, who died at the age of 84 in July, 1924.

The plaintiffs were the executors, Richard Varcoe and Robert Varcoe, of St. Dennis, and the defendant was George Morcom, timber merchant, of Old Pound, St. Stephens, who was sued as the administrator of the estate of his wife, Julia Morcom, deceased, who was a daughter of the late Mrs. Kezia Varcoe. Plaintiffs asked for a declaration that one of the leasehold houses belonged to the estate of Mrs. Varcoe and that the rent and profits accruing to the houses as to one-half since July, 1924, also belonged to the estate. The defendant asked for a declaration that he was entitled to the whole of the property which at the death of Julia Morcom in March, 1924, belonged to her. Mr. Walter Graham was for the plaintiffs and Mr. J. C. Hubbard was for the defendant.

Under the will it was disclosed that valuable China Clay shares from which the testator derived her living were left to her two sons, the plaintiffs. The lease was in the joint names of Mrs. Kezia Varcoe and the defendant, George Morcom. Mrs. Morcom, defendant's wife, died in March, 1924, and Mrs. Varcoe, her mother, three months later.

The Evidence

Evidence was given in support of the plaintiffs' case. Richard Varcoe, farmer, St. Dennis, one of the plaintiffs, said he remembered his mother, Mrs. Varcoe, and his sister, Mrs. Morcom, considering the erection of the houses. Mrs. Varcoe had her name put on the lease because she had paid out £240 in respect of the houses. Mrs. Varcoe gave Mrs. Morcom's eight children £50 each by paying it into the bank shortly before her death. Mrs. Sarah Knight, widow of the late John Knight, St. Dennis, another sister of Mrs. Morcom, said her mother and sister were on friendly terms. Her mother never intended the houses for the defendant.

Defendant said the houses were built under his supervision in 1908. Mrs. Varcoe advanced various sums, amounting altogether to £240. He himself put up £80 to £100 and carried the materials with his horses. He had always received the rents and had never accounted for them to Mrs. Varcoe; his name was on the rent roll of the Boconnoc Estate. He always paid the ground rent and did all the repairs, never receiving any money from Mrs. Varcoe for these purposes. The tenants had always been accountable to him, and he had always selected them. Cross-examined by Mr. Graham, defendant said he paid for the lease. The reason his name was on the lease was because Mrs. Varcoe said she had £800 in the bank and wanted to do something for her two daughters. Mrs. Varcoe said she wanted her name put in so that if she wanted it she could have the rent from one of the houses. Her living was from some shares in the Goonvean China Clay Co., from which for a few years she did not get very much, but in the last 20 years she had done very well from them, and therefore never required the rent. After his wife's death he offered to pay Mrs. Varcoe the £240 she had advanced if she wanted it. Mrs. Varcoe gave her other daughter two houses at St. Dennis.

Judgment for Plaintiffs

A long argument ensued. Finally His Honour gave judgment in favour of the plaintiffs, holding that one of the houses belonged to the estate of the late Mrs. Varcoe, and that the estate was also entitled to half the profits and rents since the death of Mrs. Varcoe. On Mr. Hubbard announcing that his client intended to appeal against the decision, His Honour undertook to give his judgment in writing and to grant a stay of execution, pending the appeal.

China Clay Imports for July, 1926

A RETURN of the registered imports of China Clay, including China Stone, into Great Britain and Northern Ireland, from the several countries of consignment during the month of July, 1926, indicates that a consignment of 420 tons, valued at £1,368, arrived from Belgium.

China Clay Notes and News

English China Clays, Ltd.

The directors announce a dividend on cumulative preference at rate of 7 per cent. per annum for half-year ended June 30, 1926, to all preference shareholders registered on July 24.

Death of a China Clay Authority

Mr. T. J. Malone has passed away at the age of 75. He was for many years engaged in China Clay research work for the firm of Messrs. North and Rose, and was the author of several learned treatises on China Clay operations. THE CHINA CLAY TRADE REVIEW had published articles from his pen.

New Company: Concrete Products

Pengover Concrete Products, Ltd. Private company. Registered July 17, 1926. Capital, £2,500 in £1 shares. Objects: To acquire from A. Campbell, of Lewarne, Liskeard, the benefit of certain inventions relating to improvements in process for use in the manufacture of cement pipes or tubes. The directors are: A. Campbell, Lewarne, St. Neot; Major W. H. King, Sconner House, St. Germans; secretary, F. V. Gibbes; solicitor, A. de C. Glubb, West Street, Liskeard. Registered office: The works of the company at Carthew Dumps, near Pengover, parish of Menheniot.

"Sands, Clays, and Economic Minerals"

We have received from Mr. A. L. Curtis, of Westmoor Laboratory, Chatteris, a copy of his catalogue (price 1s.) of "Sands, Clays, and Economic Minerals for All Industrial Purposes" supplied by him. After an introductory note on the uses of these materials, the catalogue classifies sands under the heading of their uses and properties, to the number of 54, including abrasive sands, moulding sands, building sands, cement testing sands, core sands, crucible sands, filtration sands, grinding sands, monazite sands, quartz sands, silica sands, and many others. The rest of the catalogue deals with clays—China, Ball, and fire—barytes, bauxite, emery, kieselguhr, fuller's earth, feldspars, etc. Under each heading a short but comprehensive account of the properties and uses of the material under discussion is given.

Indian Demand for China Clay

A fine example of growing business which is coming to British producers from Indian demands is China Clay. This product had a boom year in India during 1920-21, but in the depression of the subsequent year fell to a total import figure of 298,000 cwt. The annual aggregates since this have shown the good recovery which is being made, the figures in order being 301,000 cwt., 362,000 cwt., and in the latest year 449,400 cwt. This last is even better than in the boom year mentioned, and side by side with these figures can be set the amounts bought from Great Britain which have run to 292,000 cwt., 297,000 cwt., 306,000 cwt., and 378,000 cwt. Not only therefore have we the bulk of the business but much of the improvement is being met by our exporters. It is, however, well to note that whilst Belgium did scarcely any trade in China Clay with India prior to 1923, this competitor is now sending 45,000 cwt. and there are also growing supplies from Germany which now amount to 20,000 cwt. In this connection attention may be drawn to the possibility which exists of the exploitation of the China Clay deposits of Behar.

Cornwall Freemasons

At the annual Cornwall Provincial Lodge of Freemasons held this year at Launceston 400 brethren of the craft were present. Lord St. Levan (Provincial Grand Master) was unable to preside through having undergone an operation on the eve of the Festival, and the Deputy Grand Master (V. M. Bro. Sir D. Colville Smith, Grand Secretary) was not available, being absent in South Africa on Masonic business. Sir Alfred Robbins, P.G.W. (Eng.) and President of the Board of General Purposes Committee, who is a native of Launceston, was present and expressed his pleasure at meeting for the first time in P. G. Lodge in his native town, and conveyed to his Cornish brethren the good wishes of the Grand Master, H.R.H. the Duke of Connaught, and the latter's high appreciation of the great services rendered by the brethren in the provinces, who were the strength and lifeblood of English Freemasonry. The Deputy Pro. G. Master especially regretted

being absent, because it was in Launceston 27 years ago that he first received the appointment of Dep. Prov. G. Master. The Prov. G. Secretary reported an aggregate membership of the lodges in the province of 4,026, as compared with 3,942 the previous year. Following the reception of various reports, W. Bro. J. W. Higman, Provincial Steward of the Masonic Million Memorial Fund, presented a list showing that from 28 out of the 33 lodges £4,464 had been subscribed as promised. W. Bro. J. W. Higman was again appointed the representative of the province on the Royal Masonic Benevolent Institution.

Sodium Silicate for Paper Sizing

A book which discusses results which may be of great importance to the paper industry has recently appeared under the title of *The Use of Sodium Silicate for the Sizing of Paper*, by Th. E. Blasweiler, with foreword by C. F. Cross, F.R.S. (London: Constable and Co., Ltd., pp. 114, 10s. 6d.). The book is a translation of a German publication describing the results of investigations extending over a period of 10 years, which were carried out by the author under the direction of Emil Heuser, on behalf of the German Association of Silicate Manufacturers. In his foreword, Mr. Cross states that "the subject is rightly judged of sufficient importance to a leading industry, as a permanent contribution to its scientific technical foundations... As a model, it will commend itself as a demonstration of both the capacity and limitations of the well equipped mill laboratory in solving a problem in manufacturing developments complicated by the many factors involved; and also of the objective spirit and method of inquiry expressed in the aim to arrive at the truth, the whole truth if possible, in any case nothing but the truth... The results will be found to establish a very strong case for the more general adoption of the laboratory method of critical control of the mill operations... It is quite evident that these new silicates are a very economic form of the colloid, and can be made to contribute in various ways to the efficient sizing of papers, which also includes the improvement of the texture of the web or sheet. Other secondary effects, such as the fixation of loading and the more complex effects of fixing colouring matters, are capable of development, the lines of which have been laid down in the brochure under consideration."

An Account of the Research

The book commences with a summary of the literature of silicate sizing. This is followed by an account dealing with pure mineral sizing, discussing sizing with silicate, precipitation with aluminium sulphate in the absence of fibre, solubility of aluminium silicate precipitates, precipitation in the presence of paper pulp, precipitation of silicic acid with magnesium sulphate, the salting out of silicic acid, etc.; silicate and rosin sizing; silicate and fatty acids, including sections on sizing with the soda soap of fatty acids in conjunction with sodium silicate, sizing with an oil saponified with silicate, etc.; silicate and animal glue, including among other matters, sizing with silicate and glue and the influence of aluminium hydroxide on sizing with animal glue; silicate and starch, this section dealing with such matters as sizing with silicate in conjunction with swollen starch and sizing with starch swollen with silicate; silicate and casein, comprising accounts of sizing with casein in ammoniacal solution in conjunction with silicate and sizing with casein in silicate solution.

In the final chapter, the author states his conclusions: "The foregoing work demonstrates clearly that for many printing papers, sizing with rosin may be entirely dispensed with... Silicate sizing in this most important class of papers not only serves the same purposes, but actually excels resinous or fatty sizes in all the essential technical effects." The chief advantages of silicate sizing are summarised as follows: good working on the paper machine, and no sticking in the presses, with a smaller consumption of felts as a result; rapid and complete sedimentation of the machine water; increased strength; better handle and rattle to the paper; higher fixation of loading while retaining the handle of the paper; large capillary rise for oils and a smooth surface (printing qualities); flatness of cut sheets of the paper; and finally increased absorption and fixation of dyestuffs.

Mr. John Lovering Better

The many friends of Mr. John Lovering will be glad to hear that he is making a satisfactory recovery from the seizure he suffered over a month ago, though not yet able to get about. Mr. Lovering is over 75 years of age, but is still actively engaged in the business of his firm.

Paper Making in Great Britain

"Modern Development of Paper-Mill Plant" was the title of a paper by Messrs. W. Worby Beaumont and Leslie N. Burt, read recently before the Institution of Mechanical Engineers, in London. It was pointed out that in 1850 there were 694 mills entered as paper mills in England, 79 in Scotland, and 70 in Ireland. Of these, 333 in England, 54 in Scotland, and 27 in Ireland were working. They were nearly all small as compared with the mills of to-day. At the present time the paper mills in England numbered 260, and of these a few were not working, or were working at a loss, largely owing to fiscal difficulties, the total output being about 1,250,000 tons per year.

Death of Mrs. J. W. Higman, Jr.

After only two or three years' married life, the many friends of Mr. J. W. Higman, Jr., only son of Mr. J. W. Higman, J.P., and a local director of Messrs. H. D. Pochin and Co., Ltd., St. Austell, have been shocked to hear of the death of his wife at the early age of 28. On August 5, Mrs. Higman gave birth to her first child (which died at birth) and subsequently Mrs. Higman became so seriously ill that she had to be removed to St. Austell Cottage Hospital, where she died on August 9. At the funeral, on August 12th, there was a large attendance of sympathisers, the China Clay trade, with which both Mr. and Mrs. Higman were intimately connected, being largely represented. Mrs. Higman was the granddaughter of the late Mr. Woodman Peters (one of the founders of the firm of Messrs. Parkyn and Peters). Her untimely end is particularly tragic, for her widowed mother, Mrs. Michell, of Point Gribben, St. Austell, is now bereft of her family, her only son having been killed as the result of a motor accident about two and a half years ago.

Government Grants to Clay District Stopped

With reference to the application of the St. Austell Rural District Council for grants in aid of sewerage and water schemes in St. Stephens parish, the Government Unemployment Grants Committee have written that as a result of inquiries made they did not find the position as to unemployment in the St. Austell Rural District or in the parish concerned such as to warrant the carrying out of a scheme of relief with assistance out of the funds at their disposal. In reaching that decision the committee had not, of course, taken into account the number of men who might be temporarily stopped or working short time because of the existing dispute in the coal mining industry, neither did they consider it possible for them to do so. Careful regard had, however, been had to the circumstances prevailing, both immediately and over a considerable period prior to the dispute in question, and with these in view the committee had decided that the application was not one which could be entertained. The Clerk (Mr. F. H. Smith) said the scheme would now have to go forward as a scheme entirely chargeable on the parish. There would be a Government inquiry in due course.

Plymouth Pottery near Cookworthy's Pioneer Work

Dealing with the activities of the past year in connection with the Plymouth Gas Co. at their recent annual meeting, Mr. J. H. Ellis, the chairman of the company, referred to the establishment of a gas-fired pottery near the site associated with the pioneer work of Cookworthy, the discoverer of China Clay in Cornwall. A firm of able craftsmen, a family of potters of Staffordshire origin, he said, had taken a lease of the premises belonging to the company in Gas House Lane. "Specimens of their work made of clay raised on our property by their own labour and fired by our own gas," he said, "have been brought here for our inspection. We heartily wish them the utmost success. They start with the great advantage that the strike will not stop their production, and with this added advantage, that if the transit from Stoke-on-Trent to Plymouth is interrupted they have a good market at hand, and I trust will receive that public support

which a local manufacturer who supplies a good and cheap article is entitled to. Pottery and porcelain, too, are successfully fired by gas elsewhere in competition with the older method: Why can it not be done here?"

History Repeats Itself

The editor of the *Western Independent*, Plymouth's weekly paper, makes the following interesting comment on the commencement of this promising West of England pottery: "The most novel piece of information for the man-in-the-street in Mr. Ellis's statement is that concerning the gas-fired pottery at Cattedown, under the walls of the gas works, and 'near the site associated with the pioneer work of Cookworthy.' We have been debating for a generation the possibility of starting a pottery in Plymouth, with China Clay at our doors. What columns of print have been given to the subject, what hours of debate, what dreams! Now we open our eyes, after a temporary silence, and, behold, we have half-a-dozen potters at their wheels and kilns, actually at work. Though the enterprise is at its small beginnings, it is too good not to be a success, and the public should see to it that it is rewarded by the growth which we are sure it will deserve."

St. Austell Rural Council's Ex-Chairman Honoured

As a mark of respect and esteem for the "father" of the St. Austell Rural District Council, on the occasion of his retirement from the chairmanship of the Council, for 15 years' service in that position, Ald. F. W. Jenkin, J.P., was the guest of honour at a luncheon at St. Austell, when he was presented with an oak roll-top desk, subscribed by past and present councillors, guardians, officers and representatives of the Press. In acknowledging the gift, Ald. Jenkin, in a reference to the work accomplished by the Rural Council said that he agreed that they had spent an enormous amount of money in recent years, some wisely and some unwisely as had been said. But he pointed out that they were suddenly called upon to meet a situation in which 1,500 men are unemployed in the district. Instead of placing a burden on the ratepayers by paying out money in relief they embarked on relief schemes which had the effect of saving a lot of money by providing work. On roads, drainage and water they spent £209,000, which did not all come out of the rates, for they received over £100,000 in grants from the Government, which was brought in the district and spent for their benefit. Under the Addison scheme they built 330 houses and, in addition, a large number of others had been erected under the subsidy scheme.

In proffering the toast of "Past members of the Council," Dr. Marshall referred to several old members who were present, including Mr. J. W. Higman, J.P., who was the first chairman of the Rural Council and held the office continuously from 1894 to 1907. The expenditure in Mr. Higman's days was small compared with the hundreds of thousands of pounds the Council had been spending in recent years, but he had no doubt that the ratepayers grumbled in the same way then as they did now. Mr. Higman, who is the senior partner in the China Clay merchants firm of J. W. Higman and Co., responding, said he was pleased to do honour to whom honour was due. It spoke well of the members of the Rural Council that from 1894 until now they had had only four chairmen. Nowadays they were used to big figures and it seemed less trouble to get £100,000 now than it was to get £100 in past days. Mr. Mark Richards, a former chairman of the Guardians, in proposing "The Rural Council," said, as regards the provision of houses, that he considered they did the right thing, but they did not go far enough. He expressed the hope that the Council would provide houses for the class of people whom the subsidy houses did not touch. Mr. R. Hooper, who is Messrs. H. D. Pochin and Co.'s China Clay works manager, responding, said he had been a member of the Council for over 30 years and he believed he could claim to be the next oldest member to Mr. Jenkin. Comparing the work of the old and recent councils, he said that in the old days they got through their work much more expeditiously than they did to-day.

China Clay Shipments from Penzance—July, 1926

Arrived.	From.	Name.	Sailed.	For.
July 16	London	s.v. <i>Mary Barrow</i>	July 29	Rochester
July 18	Dartmouth	s.s. <i>Touy</i>	July 20	Runcorn
July 20	Fowey	s.s. <i>Artificer</i>	July 22	Kirkcaldy
July 30	Dartmouth	s.s. <i>Teign</i>	July 30	Rochester

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Charlestown Shipping—July, 1926

Arrivals

Date.	Vessel.	From
July 5	Henrich Luhring	Kotka
July 6	Porthleven	Plymouth
July 6	Lydia Cardell	Barry
July 15	Harvest King	London
July 19	Ruth	Barry
July 20	Mary Sinclair	Falmouth
July 22	Braemore	Plymouth
July 23	Tarragona	Plymouth
July 23	Porthleven	Bristol
July 24	Porthcarrack	Bruges
July 24	Isabella	Plymouth
July 24	Christian	Stromfors
July 24	Porthmeor	Cardiff
July 29	Robrix	Truro
July 30	Bridlen	Cardiff
July 31	La Revanche	Nantes

Sailings

Date.	Vessel.	From
July 2	Ramarie	Brussels
July 7	Porthleven	Rochester
July 13	Lydia Cardell	Rouen (Via Fowey)
July 23	Harvest King	Glasgow
July 25	Porthleven	London (Gravesend)
July 26	Tarragona	Glasgow
July 27	Mary Sinclair	London
July 27	Isabella	London (Dartford)
July 29	Porthcarrack	Antwerp
July 30	Porthmeor	Brussels
July 30	Robrix	Antwerp
July 31	Bridlen	Rouen

Fowey Shipping—July, 1926

Arrived.	Name.	Sailed.	Destination.
July 1	S.S. Mercurius	July 6	Tarpsborg
July 2	S.S. Joffre Rose	July 8	Zeebrugge
July 2	S.S. Teesbridge	July 17	Norfolk, U.S.A.
July 2	S.S. Susanne	July 8	Antwerp
July 2	M.V. Lynher	July 3	Plymouth
July 4	M.V. Cornelia	July 10	Antwerp
July 4	S.S. Adolphe Urban	July 6	Veardingen
July 4	S.S. Fagerborg	July 9	Leith
July 4	S.S. Abercraig	July 8	Ridham
July 4	M.V. Adelbert	July 9	Bremen
July 6	M.V. Gaelic	July 12	Liverpool
July 7	M.V. Maja	July 13	Drammen
July 7	S.S. Knowlgroue	July 10	Gravesend
July 7	S.S. Merwede	July 13	Antwerp
July 8	S.S. Ardgavel	July 10	Brussels
July 8	M.V. Shamrock	July 9	Plymouth
July 8	S.S. Hayle	July 9	Hayle
July 8	S.S. Farfield	July 12	Grimsby
July 9	S.S. Ferndene	July 14	Brussels
July 9	S.S. Dunmore	July 14	Par
July 9	S.S. Gronant Rose	July 16	Preston
July 10	S.S. Horn	July 16	Rouen
July 11	S.S. Kari	July 16	Harburg
July 11	S.S. Annaho	July 17	Boness
July 11	S.S. Guelder Rose	July 16	Ghent
July 12	S.S. Hayle	July 15	Zeebrugge
July 12	S.S. Dorrien Rose	July 16	Dublin
July 12	S.S. Carterside	July 16	Kotka
July 13	M.V. Lydia Cardell	July 19	Rouen
July 13	S.S. Katherine	July 15	Pentewan
July 13	S.S. Gouwstroom	July 20	Amsterdam
July 13	S.S. Scarth	July 24	Barrow
July 14	S.S. Artificer	July 20	Penzance
July 14	S.S. Dragon	July 20	Liverpool
July 14	S.S. Mourne	July 17	London
July 14	S.S. Clodoald	July 20	La Pallice
July 15	S.S. Stormest	July 24	Philadelphia
July 15	S.S. Joffre Rose	July 24	Zeebrugge
July 15	S.S. Andax	July 20	Antwerp
July 16	M.V. Hela Naval	July 20	Harburg
July 16	S.V. Altair	July 24	Bremen
July 16	S.V. Pedestrian	July 26	Par

July 16, S.V. Christian	July 26, Charlestown
July 16, S.S. Uvanenborg	July 28, Boston
July 16, S.S. Orchis	July 22, Ridham
July 16, Bedefell	July 30, Portland, Me.
July 17, S.S. Pansy	July 23, Zeebrugge
July 17, M.V. Lynher	July 18, Plymouth
July 17, S.S. Glynconwy	July 22, Birkenhead
July 17, S.S. Mersey	July 24, Garston
July 18, S.S. Svenker	July 21, Karlskrona
July 18, M.V. Laanema	July 24, Kotka
July 19, S.S. Blush Rose	July 30, Preston
July 21, S.S. Italy Maru	July 24, Philadelphia
July 21, S.S. Abercraig	July 24, Ridham
July 23, M.V. Agathe	July 27, Gothenborg
July 23, S.S. Hayle	July 30, Plymouth
July 24, S.V. Hilda	July 29, Granton
July 24, M.V. Waldemar Tornoe	July 25, Zeebrugge
July 25, S.S. Dorrien Rose	July 27, Norrköping
July 26, M.V. Altair	July 30, Oscarshamn
July 26, M.V. Vesta	July 29, Liverpool
July 26, S.S. Dorset Coast	July 27, Zeebrugge
July 26, S.S. Gronant Rose	July 27, Dublin
July 26, S.S. Guelder Rose	July 29, Brussels
July 27, S.S. Ardgavel	July 31, Rouen
July 27, S.S. Southwell	July 31, Porthoustock
July 27, S.S. Katherine	July 28, Gravelines
July 27, S.V. Paquette	July 30, Plymouth
July 27, M.V. Ycalm	July 29, Leith
July 28, S.S. Alice	July 29, Plymouth
July 28, M.V. Shamrock	July 31, Ronaz
July 29, S.S. Groningen	July 29, Falmouth
July 29, S.S. St. Mawes	August 4, Bilbao and Pasages
July 29, S.S. Horn	July 31, Runcorn
July 29, S.S. Dunmore	August 3, Porthoustock
July 29, S.S. Katherine	August 3, Odense
July 31, S.S. Ruth	August 3, Poole
July 31, M.V. Jupiter	August 3, Ridham
July 31, S.S. Westerham	

* "In Port."

Par Harbour Shipping—July, 1926

Sailings

Date.	Vessel.	Destination.
July 1, S.V. <i>Etincelle</i>		Charlestown
July 1, S.S. <i>Annenchen Peters</i>		Plymouth
July 2, M.V. <i>Regina</i>		Pentewan
July 5, M.V. <i>Karten</i>		Gravesend
July 5, S.V. <i>Velonia</i>		Antwerp
July 6, M.V. <i>Welcome</i>		Penarth
July 6, M.V. <i>Hope</i>		Charlestown
July 12, M.V. <i>Johannes</i>		Viborg
July 12, S.S. <i>Regina</i>		Jersey
July 13, M.V. <i>Katie</i>		Rochester
July 13, M.V. <i>Grit</i>		Rochester
July 15, S.V. <i>Albatross</i>		Terneuzen
July 15, S.V. <i>Leading Light</i>		Antwerp
July 16, M.V. <i>Henrich Luhring</i>		Hamburg
July 16, S.S. <i>Dunmore</i>		Preston
July 16, S.S. <i>Robrix</i>		London
July 20, S.S. <i>Norrix</i>		Gravesend
July 20, M.V. <i>Hope</i>		Plymouth
July 22, S.V. <i>Clymping</i>		Antwerp
July 23, S.S. <i>Ruth</i>		Penarth
July 26, M.V. <i>Mary Jones</i>		Bristol
July 27, S.V. <i>Lady Daphne</i>		Rochester
July 27, S.S. <i>Regina</i>		Antwerp
July 28, S.V. <i>Gauntlett</i>		Garston
July 28, S.V. <i>Hector Cundy</i>		Gravelines
July 28, S.V. <i>Guiding Star</i>		Rochester
July 29, <i>The Sirdar</i>		Polperro
July 29, M.V. <i>Hope</i>		Plymouth
July 30, S.V. <i>Pedestrian</i>		London
July 30, S.V. <i>J.N.R.</i>		Plymouth
July 31, S.V. <i>Industry</i>		Plymouth

Arrivals

Date.	Vessel.	From
July 2, M.V. <i>Hope</i>		Plymouth
July 6, M.V. <i>Katie</i>		London
July 8, S.V. <i>Albatross</i>		Plymouth
July 8, M.V. <i>Johannes</i>		Landernan
July 9, S.S. <i>Regina</i>		Terneuzen

Date.	Vessel.	From
July 9, M.V. <i>Grit</i>		Torquay
July 9, M.V. <i>Hope</i>		Porthoustock
July 12, S.V. <i>Guiding Star</i>		London
July 12, M.V. <i>Henrich Luhring</i>		Charlestown
July 13, S.V. <i>Leading Light</i>		Plymouth
July 14, S.S. <i>Dunmore</i>		Fowey
July 15, S.V. <i>Lady Daphne</i>		Truro
July 15, S.S. <i>Robrix</i>		Plymouth
July 16, S.S. <i>Norrix</i>		Truro
July 16, S.V. <i>Clymping</i>		Bridport
July 19, M.V. <i>Mary Jones</i>		Falmouth
July 20, S.V. <i>Gauntlett</i>		Plymouth
July 21, S.S. <i>Ruth</i>		Charlestown
July 22, S.V. <i>Hector Cundy</i>		Truro
July 23, S.S. <i>Regina</i>		Terneuzen
July 26, S.V. <i>Pedestrian</i>		Fowey
July 28, <i>The Sirdar</i>		Truro
July 28, M.V. <i>Hope</i>		Porthoustock
July 28, S.V. <i>J.N.R.</i>		Porthoustock
July 29, S.V. <i>Industry</i>		Gweek
July 30, S.S. <i>Snow Queen</i>		Penryn
July 30, <i>The Sirdar</i>		Polperro

China Clay Exports for July, 1926

A RETURN showing the exports of China Clay, including Cornish or china stone, the produce or manufacture of the United Kingdom, from the United Kingdom to each country of destination registered during the month ended July 31, 1926:

COUNTRY OF DESTINATION.	CHINA CLAY.	
	QUANTITY.	VALUE.
	Tons.	£
Finland	2,346	2,418
Sweden	1,101	2,502
Norway	1,434	2, 55
Denmark (including Farøe Islands)	480	537
Germany	4,389	8,524
Netherlands	4,757	9,915
Belgium	7,660	13,231
France	4,152	6,958
Switzerland	72	190
Spain	1,748	3,975
Italy	1,668	5,041
Greece	5	0
Egypt	—	1
China	8	41
United States of America	47,244	97,971
Mexico	40	147
Argentine Republic	25	101
British India—Bombay	2,454	10,173
British India—Bengal, Assam, Bihar and Orissa	781	2,246
Australia	65	427
Canada	210	784
Total	80,640	167,272

July Deliveries

Last Year's Trade Exceeded

CONSIDERING the detrimental effect the prolonged coal strike is having upon the industries of the country, the maintenance of such a big tonnage as 87,516 tons, which was despatched in July, is very gratifying and is a tribute to the capacity and determination of the China Clay industry to retain its markets. The July figures represent a drop of only 5,393 tons on the total for June, but the June deliveries were excessive on account of special efforts to overtake the big drop in May due to the general strike. The biggest drop was in China Clay of 7,650 tons, but an increase in the volume of china stone of 1,871 tons and an increase in deliveries of ball clay of 386 tons brought the net decrease to the figure above stated. Comparing the trade in all classes for the seven months this year with the corresponding period last year there is a tonnage in favour of this year of 3,424 tons. The increase in China Clay is 7,621 tons, but china stone shows a decrease of 1,907 tons and ball clay a decrease of 2,290 tons. This is a satisfactory result having regard to the dislocation and difficulties of business the industry has been experiencing during the last three months.

Following are the details of deliveries in July compared with the corresponding deliveries in July last year, together with

the total tonnages for the seven months this year and last year:

Port.	China Clay.		China Stone.		Ball Clay.		Total.	
	1926.	1925.	1926.	1925.	1926.	1925.	1926.	1925.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Fowey ...	68,183	55,075	4,674	5,850	1,463	2,787	74,320	63,712
Par	5,102	2,976	183	370	—	—	5,287	3,346
Charlestown ..	3,377	3,636	—	—	—	—	3,377	3,636
Penzance ..	992	—	—	—	—	—	992	—
Plymouth ..	1,066	1,731	—	—	24	31	1,090	1,762
Newham ..	—	—	—	310	—	—	—	310
Falmouth ..	256	—	—	—	—	—	256	—
By rail	2,194	4,624	—	—	—	—	2,194	4,624
July	81,170	68,042	4,859	6,530	1,487	2,818	87,516	77,390
6 months ..	439,569	445,076	19,546	19,782	10,122	11,081	469,237	475,939
7 months ..	520,739	513,118	24,405	26,312	11,609	13,899	556,753	553,329

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

BOWATER (W. V.) AND SONS (1926), LTD., London, E.C., paper manufacturers. Registered July 29, £10,000 land charge, to United Kingdom Temperance and General Provident Institution, 196, Strand, W.C.; charged on 121, Queen Victoria Street, E.C.

BOWATER'S PAPER MILLS, LTD., Northfleet. Registered July 3, £50,000 charge, dated June 29, 1926, to Kleinwort Sons and Co., bankers; charged on certain stocks of wood pulp stored at company's pulp yard at Northfleet and/or in transit. *£400,000. June 30, 1926.

NORTH WALES BRICK AND TILE CO., LTD., Liverpool: Registered June 30, £4,000 2nd debenture, to T. D. Stubbs. Bryn Gwynant, Beddgelert; general charge. *£3,612 14s. 4d. December 31, 1924.

PERRETT'S BRICK AND TILE CO., LTD., London, W.C. Registered July 28, £7,000 debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issue, £5,000; general charge. *£14,080. December 17, 1925.

PORTISHEAD BRICK AND TILE WORKS, LTD., Registered July 15, £1,000 debenture, to Branch Nominees, Ltd., 15, Bishopsgate, E.C.; charged on land at Portishead, etc., also general charge.

REDHILL TILE CO., LTD., Registered July 5, £200 and further advances not exceeding £800 charge, to T. Cotching, Horsham, solicitor; charged on property in Honeycock Lane, Horley. *£4,500. July 17, 1925.

THYNNE (H. AND S.) LTD., (late GODWIN AND THYNNE, LTD.), Hereford, tile manufacturers. Registered July 17, £10,000 debenture, to H. B. Everett, 1, Broad Street, Hereford, and another; general charge. *£17,800. February 11, 1926.

Satisfactions

CROPPER (James) AND CO., LTD., Burnside, paper manufacturers. Satisfaction registered July 7, £3,000, part of amount registered. July 25, 1923.

DICKINSON (John) AND CO., LTD., London, E.C., paper makers. Satisfaction registered July 23, £5,497, part of amounts registered July 1, 1912, and January 21, 1919.

JACKSON'S MILL-BOARD AND PAPER CO., LTD., London, E.C. Satisfaction registered June 2, £8,350, registered November 3, 1916.

SIMPSON (T. A.) & CO., LTD., Burslem, tile manufacturers. Satisfaction registered June 10, £1,500, registered November 14, 1919.

WADDINGTON (J. H.) AND CO., LTD., Beighton, paper makers. Satisfaction registered July 19, £7,000, registered September 29, 1924.

WHITELEY (B. S. & W.), LTD., Pool, Yorks, paper makers. Satisfaction registered June 7, £1,000, part of amount registered September 16, 1924.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests.
Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., Bouverie House, 154, Fleet Street, E.C.4. All communications relating to Advertisements, Subscriptions, etc., should be sent to the Manager, "The China Clay Trade Review," at this address. Telegrams—"Allangas, Fleet, London." Telephone—City 0244 (10 lines).

China Clay Industry Organisation

READERS of this review who are familiar with the efforts that have been made for several months to bring the industry within the purview of one organisation will be interested at the announcement, details of which are given elsewhere in this issue, of the success of the negotiations so far. It will be seen that the first step in the establishment of an "all-in" association has been taken by the registration of a company bearing the same title as the old association which broke up two years ago—namely, Associated China Clays, Ltd. Although no announcement has been made for publication in the Press as to the successful results of the negotiations that have been proceeding, the registration of the company is an outward and visible sign that there is a preponderance of support on the part of individual China Clay producers for an organisation on the lines recently indicated in this journal.

After Two Years

It is interesting to note as a matter of history that it is just two years this month since the last comprehensive association was disbanded through internal disintegration and outside competition. In the two years that have intervened, individual producing firms have been carrying on somewhat in the dark as to what was going on in the industry, in consequence of the loss to them of an organisation which kept them posted periodically as to the trade position, ruling prices, and the grading of particular classes of China Clay.

While the comprehensive association broke up two years ago, a number of the biggest firms and some small ones, realising the value to them of maintaining the machinery of the old association, formed a new organisation which was mainly concerned with the production of best clays, although its members were producers of common clays also. This body, benefiting by the experience of the past, has linked up with the larger body now constituted, which, in the event of there being no hitch in the final arrangements, will function on lines somewhat similar to the old association but in a manner which is likely to ensure the loyal support of all its members, who represent all but the smallest fraction of the total trade.

New Organisation's Policy

It would not be politic or advisable to divulge the arrangements that are outlined for serving the interests of producers as well as buyers of China Clay, but it may be stated without revealing any secrets that the policy of the new organisation will be advantageous to buyers, whether middlemen or consumers, as well as to China Clay producers. It cannot be too frequently emphasised that the organisation which the China Clay producers have now decided to set up, and whose functions will not commence to operate until three months hence, will concern itself not only with the pricing the clays of its members, but also with other matters essential to the prosperity of the industry. Under the "go-as-you-please" conditions which have been prevailing during the last two years, buyers could never be so certain of the quality of the particular clay they might be purchasing as they could be under such a system of grading as the new association will operate.

It will also be the business of the association to investigate markets, to ascertain how they are being supplied, what clays of foreign countries are in competition with the home product, how to develop markets which may have been temporarily taken from home producers and for what reason these markets have been lost, to investigate complaints as to the quality of clays supplied by particular producers, to take steps to bring to the notice of producers any defects in the quality of their clays, indicating what these defects are, and a number of other matters which from time to time will be brought to the notice of the association executive. China Clay producers are too much alive to the value of the industry's world-wide markets to be likely to do anything as an association, which they would not do as individual and independent producers, to jeopardise the prospects of further developing markets by raising prices unreasonably. The competition of domestic clays in foreign countries, actual and threatened, against English China Clays in this country, and the incentive of consumers to use cheaper substitutes when China Clays go beyond a certain figure, have been, are, and will be potent factors in preventing profiteering.

A New Era of Prosperity if —

Such an association as seems likely to function in the near future should, if its policy is energetically pursued and loyally supported by all its members, become a powerful factor in re-establishing the industry on a profitable basis, and secure to those financially interested in the industry a fair return for their capital and enterprise, while serving as an insurance to buyers and consumers and enabling them to depend on the clays they buy being of the quality offered at the particular prices quoted. It must be a source of satisfaction for buyers to feel that they are thus able to secure their supplies while feeling that they can rely upon their purchases always being up to standard. By the successful setting-up of the association an end should be put to the ruinous price-cutting that has been going on for the last two years, which has left those dependent upon the industry impoverished and the financial stability of the less substantial firms seriously threatened. If all concerned agree in showing the same spirit of patience, forbearance and determination as those who have for the past few months been endeavouring to bring about the establishment of the new organisation, there is every reason for predicting that the industry will enter upon a new era of prosperity, which will inspire renewed confidence in its revenue-producing possibilities.

The Coal Situation

The satisfaction to which the announcement of the formation of the new association will give rise would be greatly increased if the difficulties of the coal situation had also been surmounted. Unfortunately this is not the case. We pointed out last month that owing to the increase of coal costs, there might, apart from the formation of an association, be an upward trend in the prices of China Clay. Should this occur, it is satisfactory to think that the "all-in" association will be able to handle the matter more reasonably, from every point of view, than could be done by a number of independently-acting producers.

All-In China Clay Association

Registration as Limited Company

ALL who have at heart the prosperity of the China Clay industry of Cornwall and Devon—producers, shareholders, workers, and those indirectly interested—will learn with a feeling of satisfaction the announcement of the registration of Associated China Clays, Ltd., with its registered office at St. Austell. This marks the successful termination of labours and negotiations, of many months duration, by those who believe, as they did at the time of the break-up of the former Associated China Clays, Ltd., late in 1924, that a co-operative organisation is essential to the best working of the industry. The greatest credit is due to the unswerving patience of the Executive of the "outsiders" (the producers not in China Clay Producers, Ltd., the best clays Association), of which Mr. A. J. Perry was honorary secretary, and Mr. E. J. Hancock, chairman, and to the sympathetic consideration given by representatives of China Clay Producers, Ltd. The formation of the new "all-in" Association will be a great stimulus to the district, and the industry has profited by the lessons of the old association to remedy weaknesses in the new and ensure for it strength and permanence.

Constitution of the Association

Associated China Clays, Ltd., was registered on August 30, 1926, as a company limited by guarantee—not having a share capital—with 100 members, each liable for £10 in the event of winding up. The objects of the company are to ensure and accelerate the better distribution of China Clay among the customers who purchase clay from the members of the company; to take any steps that may have for their object economy in the production, carriage, and distribution of China Clay, or the improvement or maintenance of selling prices; to deal in or act as agents for the sale or purchase of China Clay of all kinds; and to carry on business as miners, quarry owners, ship owners, etc.

The management is vested in a Board, the first members of which are: T. M. Stocker, Trelawney, St. Austell; J. S. Lovering, Polkyth; E. J. Hancock, Bay House; W. Wedlake, Mt. Charles; J. Hoyle, Glebe Cottage, St. Austell, director of Manchester China Clay Co., Ltd.; A. J. Perry, Beech Road, China Clay Works manager; and S. B. Perry, Penvalle, St. Austell, director of New Halwyn China Clay Co., Ltd. All are actively engaged in China Clay production.

The Board is to consist only of members of the company or of directors of any companies which are members, but, save with the consent of the Board, no member shall be qualified to hold office as a director who is the owner of any business producing British China Clay in respect of which he has not entered into a membership agreement, and holds controlling interest in any company, or is a member of any firm producing British China Clay, which is not a member of the company, or holds any office in any such company or firm. The secretary of Associated China Clays, Ltd., is S. Benson; the solicitors are Rawle, Johnstone and Co., 1, Bedford Row, London, W.C.; and the registered office is The Old House, St. Austell.

Air in Clay Slips

THE plasticity of a clay slip is frequently spoiled by over pugging, due to an excess amount of air being absorbed by the plastic mass whilst passing through the mill. This defect requires attention, especially in the case of certain China Clays. A pan mill removes air more effectively than a pug mill, but excessive treatment in a pan mill may again introduce air. When a sample of filterpressed clay, which contained 9.58 per cent. of air, had been passed through a pug mill, it absorbed, during the process, an additional 0.27 per cent. of air. Another sample which was passed through the mill four times in succession absorbed 8.12 per cent. of air. Various authorities recommend different methods for determining the volume of air present in a plastic mass, amongst them being one in which kerosene is employed. Disintegration of the clay cannot be accomplished by kerosene, neither does the latter dissolve air, and by its agency the amount of entrapped air in a clay paste may be ascertained in the following manner: A weighed or measured sample is placed in a flask filled with kerosene and joined to a gas-measuring tube, which is also filled with the oil. Displacement of the kerosene occurs when boiling water is introduced into the flask, which disintegrates the clay, and any air so released gathers in the measuring tube. By

immersion in a water bath the flask is heated, and the bottle, in which the liquid displaced from the measuring tube has gathered, is joined to a vacuum pump in order to minimise any difficulty in collecting the air. In about a quarter of an hour the pump is disconnected, when the volume of air may be readily measured. Claim is made that by the foregoing method not only can the soundness of the pugged material be determined, but that the correct setting of the blades in the pug mill may be simultaneously ascertained.

U.S. Production of Fuller's Earth

Increased Production in 1925

THE production of fuller's earth in the United States in 1925 was 206,574 short tons, valued at \$2,923,965, it is announced by the Bureau of Mines, Department of Commerce, which is preparing a report on the subject, in co-operation with the Geological Surveys of Alabama, Florida, Georgia, Illinois, and Texas. This is an increase of 16 per cent. in quantity and 11 per cent. in value compared with 1924. These increases were due in part to the reappearance of California and Nevada as producers of fuller's earth, though every State that reported production in both 1924 and 1925 showed an increase. The output was reported by 14 operators in 7 States in 1925, namely, California, Florida, Georgia, Illinois, Massachusetts, Nevada, and Texas; in 1924, production was reported by 13 operators. California and Nevada reported no production in 1924, and Alabama, which was a producer in 1924, reported none in 1925. Georgia was the leading State in production in 1925, with Florida second and Texas third, as in 1924. These three States produced 85 per cent. of the total output. The average value per ton of fuller's earth was \$14.15 in 1925 compared with \$14.79 in 1924.

Fuller's earth is a term used to include a variety of natural substances that possess the property of absorbing grease or clarifying, bleaching, or filtering oil. They are mostly clay-like substances, though recently discovered material in the West, which is of different character, is said to be superior to the eastern fuller's earth. The original use of fuller's earth was in the fulling of cloth, but little of it is now used for this purpose. It is used almost exclusively in the bleaching or filtering of vegetable and mineral oils. Until 1895, when fuller's earth was successfully produced commercially in Florida, the United States was entirely dependent on foreign supplies. The imports have on the whole been decreasing in recent years. In 1925, however, they were 8,015 short tons, valued at \$111,295, an increase of 10 per cent. in quantity and 20 per cent. in value. Notwithstanding this increase the quantity of fuller's earth imported in 1925 was the smallest, except in 1924, since 1897. The exports of fuller's earth are not separately shown by the Bureau of Foreign and Domestic Commerce, but five producers reported that in 1925 they exported 6,195 short tons of fuller's earth, which was a slight decrease from 1924.

More Paper Mills for Canada

A RECENT development that is doing much to enhance the importance of the Canadian pulp and paper industry is the growing movement of American mills towards Canada, due to the diminishment of their pulp wood limits, and the fact that their water powers have, with the growth of population, attained more value for central station purposes than for pulp and paper manufacturing. There are no less than 116 pulp and paper mills in Canada operating water power developments to furnish their own motive power. These mills have a combined installation of 481,971 h.p. A number of them purchase additional power from central station organisations, while still other mills purchase all their power.

Clay Working Machinery

DURING the course of the seventeenth meeting of the Refractory Materials Section of the Ceramic Society, held last week in Leeds, Mr. H. M. Ridge read a paper on "Modern Clay-working Machinery as used on the Continent," in which he advocated a more widespread adoption in this country of certain types of labour-saving machinery in the grinding and mixing of clay. He said our manufacturers were behind the Continental clay ware manufacturers in the use of such machinery.

China Clay Notes and News

Indian Pottery Demands

Statistics of Great Britain's share of the china and earthenware trade show that while the total value of imports to India increased during the year ended March, 1925, imports from the U.K. decreased to the advantage of Japan and other countries. The bulk of the goods supplied by Japan consists of low-grade articles for native use, and the competition to be encountered in the medium and better-class trade is not particularly keen. From a study of the customs returns relating to all classes of china ware, earthenware, and clay products, however, it will be seen that British manufacturers have steadily lost ground since 1921, and the position therefore needs earnest investigation. Imports from Great Britain were: 1921, £463,934; 1922, £410,681; 1923, £334,455; 1924, £268,130. The quality, style and appearance of British goods appear to be quite suitable for the needs of the market, but more energetic sales methods must be adopted if an improvement is to be obtained, particularly as competition from Continental sources is growing.

Details of Indian Imports

Tableware.—Approximately 50 per cent. of the supplies of table ware, including tea, breakfast, dinner and coffee services, teacups and saucers, plates, bowls, dishes, jugs, etc., are drawn from the United Kingdom. The share of other countries are respectively: Japan, 20 per cent.; Germany, 8 per cent.; China, 4 per cent.; and the remainder from Holland and Belgium. Imports from Japan mainly comprise cheap tea sets with which British firms could hardly hope to compete. Imports of china and earthenware from Great Britain during 1924 amounted in value to £9,442, compared with £7,157 in 1923 and £6,356 in 1922. This position is distinctly encouraging, but continual attention is necessary as both German and Czechoslovakian manufacturers are making energetic efforts to secure a footing in the market. The bulk of the tableware required, however, is of the earthenware variety, and in this branch British goods have lost ground, as the following values of imports indicate:—1921, £134,008; 1922, £134,756; 1923, £104,923; 1924, £89,797. As domestic articles form the largest individual imports, no effort should be spared to secure a larger share of this business.

Sanitaryware.—Great Britain practically monopolises the trade in sanitaryware, the only serious competition emanating from Japan and America. British trade, however, decreased during 1924 compared with the previous year, the value of exports being £57,260 and £77,946 respectively. This heading includes earthenware, stone and fireclay pipes and tubes, general sanitaryware of earthenware, and enamelled fireclay.

Electrical Porcelain.—The demand for electrical porcelain is not large, and British firms already enjoy the bulk of the business. Imports from Great Britain during 1924 were valued at £16,082, compared with £13,299 during the previous year, and future prospects are bright. Competition from foreign sources is not keen, but local production of electrical insulators is rapidly increasing, and is likely to retard business in this direction. Lower quotations would appear to be the only means of combating this local competition.

Devon Potter's Death

The death has occurred at his residence, "Allendene," Morgan Avenue, Torquay, of Mr. William Robinson, J.P., managing director of the Bovey Pottery Co., Ltd., Devon, and one of Mid-Devon's best known and most highly respected personages. Until a couple of years ago the late Mr. Robinson had enjoyed good health, and he had, even until a week prior to his death, been able to keep in active touch with the important factory of which he was the head. He was 70 years of age. The late Mr. Robinson's connection with the Bovey Pottery Co., Ltd., extended back more than half a century. His father held an important position at the Bovey potteries when they were owned by the Divett family, and he followed in the footsteps of his father, mastered the technicalities of the pottery industry, and in due course attained to a financial interest in the undertaking when a change came about in the proprietorship. He introduced many important reforms at the works, and restored the Bovey Potteries to a flourishing condition, after they had passed through an anxious and critical period.

Sands in Glass Industry

Glass sand stands third in the list in tonnage produced in the U.S.A., according to a report by the Bureau of Mines. Abrasive sand includes several grades of products, among which may be classed glass-grinding sand, stone-sawing sand, sand for abrasive papers and various grinding and polishing operations. Crude rolled plate glass requires rough grinding to remove inequalities of the surface before it is given the final grinding and polishing. Sand is used for this purpose. The specifications are not strict and the cheapest sand that answers the purpose is generally used; so, in nearly all cases, local supplies fill the requirements. From two to three tons of sand are required to grind one ton of plate glass. The sand should be free from large grains and any rubbish which might tend to choke the pipes in the circulating system. High silica content is not essential, except that impurities would usually be softer than the quartz grains and hence of no value. Very fine material and clay are objectionable only to the extent that they reduce the amount of proper quartz grains present. Where no other supply is available, the same sand is used for grinding as in the glass mix. One company in the Central States, mining their own sand for glass, dry part of their sand for the mix and divert the balance before drying to the glass plant for grinding. All the sand passes 20 mesh, and only a small amount is retained on 28 mesh; 91 per cent. is retained on 150 mesh. The sand is a rounded grain product. Producers in the Illinois district market some of their product for this purpose. This has been screened through 20 mesh. Only the fines removed in washing are taken out. An impure sand, containing rounded grains of stone which are not quartz, or much mica, is unsuitable. Any large grains, especially of quartz, are objectionable in that they may make deep scratches in grinding that are difficult to remove in the polishing process.

"Cement, Concrete and Bricks"

The industries concerned in the manufacture of cement, concrete and bricks represent, in a very interesting way, three stages in the evolution of industry from rule of thumb methods to work on a scientific basis. In the preface to the second edition of his book on *Cement, Concrete and Bricks* (London: Constable and Co., Ltd., pp. 441, 24s.), Mr. A. B. Searle states that "until a few years ago the brick industry of this country had no men of sufficient scientific training to study adequately the constitutions of the materials used or the chemical and physical changes which occur during manufacture. Consequently the industry was largely worked by rule of thumb, and men had often to pay very dearly for their experience, simply because there was no source from which to obtain guidance on the complex technical problems associated with their work."

"The manufacturers of cement have been more fortunate, for they realised at an early stage that success or failure depended largely on maintaining a mixture of constant chemical composition; they found that tests were necessary at so many stages in the manufacture that the employment of several chemists became necessary. With this scientific assistance the chemical and physical laws affecting the production of cement were studied with very gratifying results, and though much remains to be done, the importance of a knowledge of chemistry in the manufacture of cement has been fully established."

"Concrete is in an intermediate stage so far as the application of science to its production is concerned. It does not appear to lend itself to such definite study as cement, on the one hand, or the changes produced by heat in brick materials on the other, yet the physical properties of concrete and the light it throws on many of the problems met with in the manufacture of bricks, are sufficiently important to render its study invaluable, while the increasing use of concrete by engineers and builders renders a thorough knowledge of its characteristics, under various circumstances, quite essential."

Contents of the Book

The chapter headings of the book are as follows: the raw materials for cements; methods of cement manufacture; the chemical and physical changes in cements; the changes which occur in setting and hardening; testing the properties

of cements; the components of concrete and their properties; the preparation of concrete; reinforced concrete; special properties of concrete; testing concrete; the raw materials for bricks; methods of brickmaking; the chemical and other changes in drying and burning bricks; the properties of bricks, siliceous bricks; and basic and neutral bricks. The chapter on chemical and physical changes in cements may be cited as an example of the manner in which "pure" chemistry (both structural and physical) has percolated into the commonest industries. Its perusal emphasises the need of such an institution as the Building Research Station, where fundamental research on this and kindred subjects may be continually pressed forward. In the discussion of methods of brickmaking the author makes a strong point of the importance of technical knowledge.

Finnish Vice-Consul at Falmouth

The Mayor of Falmouth (Mr. T. A. Webber) has been informed that Mr. R. Barclay Fox, Penjerrick, Budock, and of Falmouth, has been appointed Finnish vice-consul at Falmouth.

Clay Purification Patent No. 20634/25

Erdwerke München O. Lietzenmayer, 1, Max Josefstrasse, Munich, Germany. Clay is purified by making it into a paste with enough acid to combine with the impurities, then drying the paste by heat, an air current, or by vacuum, and then leaching the mass with warm or cold water. The purified sludge is dried and ground. The degree of drying to which the clay and acid mixture is submitted is such as to leave the impurities in a form in which they are soluble in water.

Charlestown Customs Officer's Retirement

The retirement on September 6 of Mr. A. Titheridge after 35 years in the Customs service directs attention to a public servant who has rendered faithful service to his country in a variety of ways.

He entered the service in 1891 at Harwich and was transferred to Cowes in 1897, London in 1911, and Charlestown in 1921. He served in the war in the Essex regiment from 1914 to 1917. We understand that he is to be invested at an early date with the King's decoration for long and faithful service in the Customs and Excise, a distinction only conferred for 30 years' service and over. Mr. Titheridge will be missed at Charlestown, especially by captains of vessels visiting the port and by China Clay shippers, it being one of his duties to ascertain particulars of incoming and outgoing cargoes. He will be remembered as a painstaking and genial official who carried out his duties in an unofficial and conciliatory spirit.

Road Construction Mixtures Patent 246,065

Composition of bituminous mixtures for use in road construction and the like. Universal Rubber Paviers (Manchester 1923), Ltd., Canning Street, Audenshaw, near Manchester, and A. E. Brown, B.Sc. (Lond.), Kavanagh Lodge, Brentwood, Essex. It has been found that by adding to bitumen compounds forming the subject of specification No. 246,186, containing clay colloiddally dispersed in the bitumen, with or without the addition of an oil flux, residual products of the manufacture of gutta percha as, for instance, the product known commercially as gutta-percha pitch and/or the residual products of the manufacture of balata, and/or low-grade rubber-like substances such as Pontianac and the like, for instance, Palembang, Accraflake, etc., or a mixture of them, the property of adhesiveness of the resultant product is considerably increased and renders it very suitable for the purposes before mentioned (three claims).

Cornwall Unemployment Position

In the case of ten exchanges in the Mid and West Cornwall area at the beginning of this month there were increases in the figures of unemployment. The decreases were in the case of Redruth (2 only), Camborne (4 only), and St. Just (21). Falmouth figures have increased by 21, Hoyle by 16, Penzance by 47 and St. Austell by 16. Truro showed an increase of 6, whereas the previous week the total had dropped to 86. The total of unemployment in Mid and West Cornwall as shown by the figures was 2,749 compared with 2,655 for the previous week. The details are: Redruth 500; Camborne 472; Falmouth 303; Fowey 94; Hayle 253; Helston 33; New-

quay 26; Penzance 349; Perranporth 9; St. Austell 284; St. Columb 50; St. Just 284; Truro 92. Of the above numbers 707 men, 6 boys, 131 women and 21 girls were known to be working short time or stood off temporarily, or were in casual employment.

Foundry Moulding Sand

There is a steady demand for really good foundry sand, and doubtless there are many virgin deposits that could be profitably worked. The essential features of a good moulding sand are permeability, capacity to stand high temperatures, ready removal from casting and compactness to resist the pressure of the liquid metal. Excess lime makes the sand fusible, and metallic oxides also impair the refractory qualities, whilst excess clay and bond destroy porosity. Moisture should be from three to five per cent. Black sand for castings should analyse approximately 78.5 per cent. SiO_2 ; 4.75 per cent. Al_2O_3 ; 6 per cent. Fe_2O_3 ; and 0.3 per cent. CaO . The commonest impurities are soda, potash, and organic matter, but where the aggregate is under one per cent. they are not injurious. The higher the percentage of silica grain not in chemical combination with other materials, the more refractory the sand, owing to the high melting point of silica, $1,700^\circ\text{C}$., whereas iron melts at about $1,300^\circ\text{C}$.

St. Austell Hospital Finances

At the annual meeting of the St. Austell Cottage Hospital, which has proved such a boon to the China Clay district, the honorary secretary, Mr. G. H. Grenfell, and the honorary treasurer, Mr. H. Stocker, were able to report a splendid year's work in 1925. Mr. J. W. Higman presided. The annual report showed 348 admissions to the hospital during the year, compared with 350 the previous year. There were 329 operations, compared with 300 the previous year. Of the 348 patients dealt with, 320 were discharged cured and 20 relieved. There were eight deaths, due either to cases brought in late or to accidents which left no hope of recovery.

The sum received from the clay-workers was £397 16s. 11d., an increase of £76 os. 8d. This was specially gratifying, being proof of the great appreciation of those whose dependents and friends had so largely benefited by the care and attention given under treatment. In October the extension of the hospital, increasing the number of beds from 10 to 24, was formally opened by Sir Francis Layland Barratt, who was also the generous donor of the X-ray apparatus. Since the inception of the latter, by the skill of the matron operating it, it had proved to be a most valuable asset to the hospital, as shown by the results obtained with many patients who had been treated. The increased outlay of £4,295 2s. 10d., consequent upon the enlargement of the hospital, had shown itself to be more than warranted by reason of the ever increasing demand for the admission of patients, also of the waiting list of those seeking admission.

Mr. H. Stocker explained that the item of £831 under the heading of "domestic," against £453 in the previous year, was accounted for by extra expenditure on furniture, £210; decorating, £64; electric light, £56. The increase in total expenditure included £100 for land, which, like the other items, was capital expenditure which would not recur. The total expenditure for the year was £2,097 against £1,604, and the income £1,783 against £1,701. The following elections were made:—President, Sir Francis Layland Barratt; vice-presidents, Mr. J. C. Williams, Viscount Clifden, Mr. J. B. Fortesque; chairman, Mr. W. J. Nicholls; vice-chairman, Mr. T. H. Williams; hon. treasurer, Mr. H. Stocker; hon. secretary, Mr. G. H. Grenfell. Tributes were paid to the work of the treasurer and secretary for their energetic work on behalf of the hospital. Mr. Grenfell stated that £601 had so far been paid into the bank as a result of the recent fête, and the Hospital Fête Committee hoped to hand over to the hospital £500. References were made to the proposal of the committee to change the name of the hospital by omitting the term "Cottage." Mr. H. Stocker said it was felt that dealing with so many cases as it was, the hospital was now more than a cottage hospital, which was a term usually applied to institutions of from 6 to 10 beds, whereas they now had 24. It was decided to change the name to St. Austell District Hospital and to have the institution incorporated as a limited liability company.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—August, 1926

Arrived.	Name.	Sailed.	Destination.
August 1,	M.V. <i>Kongedybet</i>	August 6,	Odense
August 1,	M.V. <i>Katie</i>	August 7,	Par
August 2,	S.S. <i>Florentino</i>	August 6,	Genoa
August 2,	<i>Walter</i>	August 14,	Haynasch
August 2,	S.S. <i>Pansy</i>	August 5,	Zeebrugge
August 2,	S.S. <i>Zaanstroom</i>	August 7,	Amsterdam
August 2,	S.S. <i>Lancashire</i>	August 7,	Flushing
August 3,	S.S. <i>Ferdene</i>	August 14,	Santander
August 3,	<i>Waterwitch</i>	August 12,	—
August 3,	S.S. <i>Katherine</i>	August 5,	Plymouth
August 3,	S.S. <i>Baron Loudoun</i>	August 12,	Portland, Me.
August 3,	M.S. <i>Aarsten</i>	August 4,	Dartmouth
August 3,	M.V. <i>Theodora</i>	August 3,	Mevagissey
August 4,	S.S. <i>Dolphin</i>	August 11,	Poole
August 4,	S.S. <i>Eibergen</i>	August 17,	Portland, Me.
August 5,	M.S. <i>Sande</i>	August 10,	Skien
August 5,	S.S. <i>Avdgyfe</i>	August 10,	Brussels
August 5,	S.S. <i>Joffe Rose</i>	August 10,	—
August 6,	S.S. <i>Leaside</i>	August 11,	Antwerp
August 6,	S.S. <i>Mersey</i>	August 11,	Runcorn
August 6,	S.S. <i>Clara Monks</i>	August 11,	Fleetwood
August 7,	S.S. <i>Alice</i>	August 23,	Runcorn
August 7,	<i>Emms</i>	August 11,	Harburg
August 7,	S.S. <i>Tiro</i>	August 13,	Palamo
August 8,	S.S. <i>Mons</i>	August 24,	Antwerp
August 9,	S.S. <i>Blush Rose</i>	August 9,	Ostend
August 9,	M.V. <i>Shamrock</i>	August 10,	Plymouth
August 10,	S.S. <i>Dorset Coast</i>	August 14,	Liverpool
August 11,	S.S. <i>Gronant Rose</i>	August 11,	Holyhead
August 12,	M.S. <i>Dickie</i>	August 10,	Harburg
August 12,	S.S. <i>Horn</i>	August 14,	Antwerp
August 12,	S.S. <i>Glenbrook</i>	August 14,	Newcastle
August 13,	S.S. <i>St. Mawes</i>	August 13,	Falmouth
August 13,	S.S. <i>Munkfors</i>	August 18,	Göteborg
August 13,	S.S. <i>Pansy</i>	August 21,	Ostend
August 13,	S.S. <i>Katherine</i>	August 14,	Plymouth
August 16,	S.S. <i>Anchen Peters</i>	August 18,	Hamburg
August 16,	M.V. <i>Kathe Jurgensen</i>	August 19,	Reval
August 16,	S.S. <i>Farfield</i>	August 18,	Grimsby
August 16,	S.S. <i>Orenie</i>	August 19,	Newlyn
August 16,	S.S. <i>Allenwerder</i>	August 20,	Trangsund
August 16,	M.V. <i>Carina</i>	August 21,	Gyfe
August 16,	S.S. <i>Renzo</i>	August 21,	Genoa
August 17,	S.S. <i>Knowl Grove</i>	August 19,	London
August 17,	<i>Thurstonian</i>	August 31,	Kirkcaldy
August 17,	S.S. <i>Glenrose</i>	August 21,	Newcastle
August 17,	S.S. <i>Gouwestroom</i>	August 21,	Amsterdam
August 18,	S.S. <i>Victor</i>	August 18,	Falmouth
August 18,	S.S. <i>Wilhelmine</i>	August 22,	Par
August 18,	S.S. <i>Artificer</i>	August 19,	Methil
August 19,	S.S. <i>Hayle</i>	August 27,	—
August 19,	S.S. <i>Briarthorn</i>	August 21,	Liverpool
August 19,	S.S. <i>Brookside</i>	August 24,	Gijon
August 19,	S.S. <i>Avdglass</i>	August 24,	Brussels
August 19,	S.S. <i>Drakepool</i>	August 28,	Philadelphia
August 21,	M.V. <i>Ingeborg</i>	August 26,	Munkedal
August 22,	S.S. <i>Ferdene</i>	August 27,	Antwerp
August 22,	S.S. <i>Sunniside</i>	August 26,	Rouen
August 22,	S.S. <i>Mersey</i>	August 24,	Manchester
August 22,	S.S. <i>Dorrien Rose</i>	August 24,	Preston
August 22,	S.S. <i>Bertha</i>	August 26,	Kotka
August 23,	S.S. <i>Ernrix</i>	August 27,	Cherbourg
August 23,	S.S. <i>Guelder Rose</i>	Sept. 7,	Runcorn
August 24,	S.S. <i>Glynconey</i>	August 28,	Liverpool
August 24,	S.S. <i>Eskbridge</i>	Sept. 2,	Philadelphia
August 26,	S.S. <i>Bilton</i>	Sept. 2,	—
August 26,	<i>Regina</i>	August 28,	Pentewan
August 26,	M.V. <i>Shamrock</i>	August 28,	Plymouth
August 26,	S.S. <i>Horn</i>	Sept. 4,	Terneuzen
August 26,	S.S. <i>Gronant Rose</i>	Sept. 4,	Preston
August 28,	S.S. <i>Bedecrag</i>	Sept. 7,	Portland, Me.
August 28,	M.V. <i>Lynher</i>	August 29,	Plymouth
August 30,	S.S. <i>Vlietstroom</i>	Sept. 2,	Amsterdam
August 30,	S.S. <i>Cisneros</i>	Sept. 2,	Genoa
August 30,	<i>Paquerette</i>	*	La Pallice
August 30,	S.S. <i>Condor</i>	Sept. 2,	Antwerp
August 30,	S.S. <i>Wyke Regis</i>	Sept. 2,	Bo'ness

* "In Port."

Charlestown Shipping—August, 1926

Date.	Vessel.	From
August 6,	<i>Emma Ernest</i>	Falmouth
August 6,	<i>Kindly Light</i>	Plymouth
August 9,	<i>Porthmeor</i>	Bruges
August 9,	<i>Pegrix</i>	Pentewan
August 12,	<i>Water Witch</i>	Fowey
August 14,	<i>Wheatclade</i>	Dartmouth
August 19,	<i>Teign</i>	Dartmouth
August 22,	<i>Carl</i>	Bridgwater
August 26,	<i>Trader</i>	Truro
August 28,	<i>Darkward</i>	Gweek

Date.	Vessel.	Destination.
August 6,	<i>La Revanche</i>	Nantes
August 8,	<i>Christian</i>	Windau
August 10,	<i>Emma Ernest</i>	Rochester
August 12,	<i>Porthmeor</i>	Brussels
August 12,	<i>Pegrix</i>	Rochester
August 14,	<i>Waterwitch</i>	Aberdeen
August 16,	<i>Wheatclade</i>	Larne
August 20,	<i>Teign</i>	Larne
August 24,	<i>Kindly Light</i>	London (Dartford)
August 27,	<i>Carl</i>	Leith
August 27,	<i>Trader</i>	London
August 30,	<i>Darkward</i>	Tayport

Par Harbour Shipping—August, 1926

Date.	Vessel.	Destination.
August 6,	S.S. <i>Katherine</i>	Plymouth
August 6,	M.V. <i>Hope</i>	Penryn
August 8,	S.V. <i>Sirdar</i>	Plymouth
August 10,	S.V. <i>Alice Williams</i>	London
August 11,	S.S. <i>Balmyle</i>	Antwerp
August 12,	S.S. <i>Condor</i>	Antwerp
August 13,	M.V. <i>Hope</i>	Plymouth
August 13,	S.S. <i>Porthleven</i>	Antwerp
August 13,	S.S. <i>Kari</i>	Rouen
August 13,	S.V. <i>Guendoline</i>	Kingsbridge
August 17,	S.V. <i>Ivy</i>	Pentewan
August 21,	S.S. <i>Magrix</i>	Gravesend
August 25,	M.V. <i>Katie</i>	Rochester
August 25,	S.S. <i>Wilhelmine</i>	Antwerp
August 27,	S.S. <i>Porthmeor</i>	Terneuzen
August 28,	S.S. <i>Wheatvale</i>	Weston Point
August 28,	S.S. <i>Condor</i>	Fowey
August 28,	S.S. <i>Porthleven</i>	Antwerp
August 31,	S.S. <i>Southwick</i>	Cherbourg

Arrivals

Date.	Vessel.	From
August 4,	S.V. <i>Alice Williams</i>	London
August 5,	S.S. <i>Katherine</i>	Fowey
August 5,	S.S. <i>Balmyle</i>	Terneuzen
August 5,	M.V. <i>Hope</i>	Falmouth
August 7,	S.V. <i>Ivy</i>	Portsmouth
August 8,	S.S. <i>Condor</i>	Antwerp
August 8,	M.V. <i>Hope</i>	Penryn
August 9,	M.V. <i>Katie</i>	Mevagissey
August 10,	S.S. <i>Porthleven</i>	Penryn
August 10,	S.S. <i>Kari</i>	Falmouth
August 11,	S.V. <i>Guendoline</i>	Falmouth
August 17,	S.S. <i>Magrix</i>	Teignmouth
August 22,	S.S. <i>Wilhelmine</i>	Fowey
August 23,	S.S. <i>Porthmeor</i>	Terneuzen
August 25,	S.S. <i>Wheatvale</i>	Jersey
August 25,	S.S. <i>Condor</i>	Antwerp
August 25,	M.V. <i>Romanie</i>	Antwerp
August 25,	S.S. <i>Porthleven</i>	Penryn
August 27,	S.S. <i>Southwick</i>	Hamburg
August 29,	S.S. <i>Leelite</i>	Hamburg
August 30,	S.S. <i>Norrix</i>	Totnes

Port Harbour Tide Table, October, 1926

(British Summer Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Friday	1	1.27	2.12	9.4
Saturday	2	2.56	3.34	10.0
Sunday	3	4.6	4.33	10.10
Monday	4	4.55	5.13	11.7
Tuesday	5	5.35	5.53	12.1
Wednesday	6	6.9	6.25	12.1
Thursday	7	6.40	6.55	12.8
Friday	8	7.10	7.24	12.11
Saturday	9	7.38	7.53	12.11
Sunday	10	8.7	8.22	12.8
Monday	11	8.37	8.53	12.3
Tuesday	12	9.10	9.28	11.8
Wednesday	13	9.48	10.10	10.11
Thursday	14	10.36	11.7	10.2
Friday	15	11.43	—	9.8
Saturday	16	0.24	1.11	9.9
Sunday	17	0.59	2.44	10.8
Monday	18	3.22	3.55	11.11
Tuesday	19	4.24	4.50	13.0
Wednesday	20	5.15	5.39	13.10
Thursday	21	6.2	6.24	14.3
Friday	22	6.46	7.7	14.4
Saturday	23	7.27	7.47	14.2
Sunday	24	8.6	8.25	13.7
Monday	25	8.44	9.4	12.8
Tuesday	26	9.23	9.43	11.7
Wednesday	27	10.5	10.29	10.7
Thursday	28	10.56	11.28	9.8
Friday	29	—	0.5	9.1
Saturday	30	0.47	1.31	9.2
Sunday	31	2.13	2.51	9.9

E. CLEMENS, Harbour Master.

China Clay Exports for August, 1926

A RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom, from the United Kingdom to the several countries of destination registered during the month ended August 31, 1926:

COUNTRY OF DESTINATION.	CHINA CLAY.	
	QUANTITY.	VALUE.
	Tons.	£
Estonia	448	1,110
Latvia	150	195
Sweden	3,548	7,318
Norway	849	972
Denmark	1,216	3,303
Germany	2,068	4,356
Netherlands	2,023	4,360
Belgium	6,084	10,183
France	2,429	4,800
Portugal	22	89
Spain	2,586	4,375
Italy	817	2,450
China	11	61
United States of America	33,638	67,304
Mexico	70	285
Chile	36	145
Brazil	5	23
Uruguay	30	117
Cape of Good Hope	—	1
Bombay via other ports	1,696	7,125
Bengal, Assam, etc.	344	1,031
Australia	30	181
Canada	37	235
Irish Free State	1	1
	58,138	120,020

August Deliveries Down Total for Eight Months Up

THE deliveries of China Clay in August showed a drop of 14,000 tons from the July figures. This is due partly to the summer holidays and partly to the falling off of the rush of orders that characterised the early days of the coal strike, when buyers laid in big stocks in anticipation of a difficulty in getting deliveries. In spite of the August drop the total tonnage for the eight months this year is still above that for the corresponding period last year, there being a surplus in favour of

this year of 3,500 tons. China Clay deliveries have increased by 8,683 tons, but a falling off in China Stone and Ball Clay deliveries accounts for the lower net increase in all classes.

The details of August deliveries compared with the corresponding month last year and the eight months comparisons are as follows:

Port.	China Clay.		China Stone.		Ball Clay.		Totals.	
	1926.	1925.	1926.	1925.	1926.	1925.	1926.	1925.
Fowey	56,291	48,508	1,991	3,531	3,518	2,720	61,800	54,759
Par	3,168	3,832	390	570	—	—	3,548	4,402
Charlestown	3,167	3,904	—	—	—	—	3,167	3,904
Penzance	1,132	2,500	—	—	—	—	1,132	2,500
Plymouth	501	1,490	—	—	—	—	501	1,490
Falmouth	100	110	—	—	—	—	100	110
Newham	—	390	—	—	—	—	—	390
By rail	2,887	3,650	—	—	—	—	2,887	3,650
August	67,246	66,184	1,381	4,132	3,518	2,720	73,145	73,036
7 months	529,739	513,118	24,495	26,312	11,609	13,899	556,753	553,329
8 months	587,985	579,302	26,786	30,444	15,127	16,619	629,898	626,365

China Clay Imports for August, 1926

A RETURN showing the registered imports of China Clay (including China Stone) into Great Britain and Northern Ireland during the month of August, 1926, indicates that the imports were nil.

Chemical Materials for Pottery, etc.

A CATALOGUE of chemicals, colours, glazes, and materials for the pottery, glazed brick, glass, and metal enamelling industries has been issued by Wengers, Ltd., of Etruria, Stoke-on-Trent, being their general price list No. 58. The list, which covers 129 pages, includes among other things, raw materials for the china, earthenware, brick, glass, and enamelled ironware industries, such as China Clay, blue clay, silica, feldspar, etc.; chemical and other products; metallic oxides, and compounds; glazes of all descriptions; underglaze colours, enamel colours, liquid gold and lustres; colours, oxides, and materials for enamelled iron; phosphor bronze lawns; chromo-lithograph enamel colours; matt or bronze enamel colours; prepared oxides or body stains; machines and apparatus of all descriptions for pottery and tile manufacturing, vapo-painters, air compressors, etc.; crucible furnaces; muffle furnaces; pulverising cylinders; and a very large variety of other materials and requisites.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

CROWHURST (E. B.) AND CO., LTD., London, E.C., paper manufacturers.—Registered August 23, £250 debenture, to H. C. Bound, 7-8, Walbrook, E.C.; general charge.

REDHILL TILE CO., LTD.—Registered August 9, £200 and further advances not exceeding therewith £800 charge, to T. Cotching, Horsham, solicitor; charged on property at Salfords, Horley; also registered August 12, £300 charge, to T. Cotching, Horsham, solicitor; charged on lands at Salfords, Horley. *£4,500. July 17, 1925.

Satisfactions

OLIVES PAPER MILL CO., LTD., Bury.—Satisfactions registered August 23, £150,000, registered September 14, 1920; £50,000, reg. September 26, 1921; and £100,000, registered March 16, 1922.

PERRETT'S BRICK AND TILE CO., LTD., London, W.C.—Satisfaction registered July 30, all moneys, etc., registered August 31, 1921.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests.
Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., Bouverie House, 154, Fleet Street, E.C.4. All communications relating to Advertisements, Subscriptions, etc., should be sent to the Manager, "The China Clay Trade Review," at this address. Telegrams—"Allangas, Fleet, London." Telephone—City 0244 (10 lines).

China Clay Organisation Collapse

THE collapse of the new China Clay organisation which, after many months of negotiation, was formed with every prospect of success, has come as a severe blow to the industry. Its effect is likely to be far-reaching, and has already brought about the stoppage of operations in some works whose owners were grasping at the new Association as the last straw to stave off insolvency.

The immediate cause of the new Association failing to function was the refusal at the last moment of one or two firms to sign the agreement to which they had previously given their tentative assent. On the strength of the decision of the producers to subscribe to the terms of the scheme, the company was duly registered, as stated in our last issue. It therefore came as a shock when the circular was sent out to the producers stating that, through an insufficient number of agreements being signed, the organisation could not go on. The collapse is all the more aggravating because in the end it rested with only one firm who insisted on the acceptance of its own terms as a condition precedent to joining. So convinced were some of the oldest established firms that the safeguards provided in the scheme were adequate to protect the interests of the Association that they were prepared to go on, but the opinion of the majority against it prevailed. And so the industry once again reverts to the old policy of go-as-you-please and the intensifying of the internecine competition that has seriously embarrassed so many firms.

The Loyalty of the Pioneers

The irony of the situation is that all of the old-established companies, in which the successors of the pioneers who established them are still largely interested and actively engaged, have been amongst the keenest supporters of an all-in association, though financially and productively they needed such an organisation the least. They have been and are still the backbone of the industry. That they have not been jealous of the enterprises of comparatively newcomers to the industry has been proved by their attitude towards the association idea which, carried into effect, would enable several of them to survive the depression caused by low selling prices and high production costs of the cheaper grades of clay. One effect of the failure of the Association will be that the companies whom an Association would have benefited most will be unable to stand the strain to which they will be subjected by the keenness of the competition they will be called upon to face in the next few months.

Coal Strike Burden

On top of the new situation created by the collapse of the Association is the unanticipated burden of the coal strike. While firms have still to maintain the credit system with the customers to whom they sell their clays, they have now to pay cash for their deliveries of foreign and British coal whereas formerly they were able to rely upon two or three months' credit. This sudden inroad upon the cash reserves and cash facilities has seriously embarrassed the less prosperous firms, with the result that they have had to postpone the fulfilment of orders and in some cases have been unable to execute orders through

difficulty in maintaining their coal supplies. In fact, some works have had to close down, while others have been compelled to lessen the number of hands.

At a special meeting of St. Austell coal merchants called by the local coal officials recently, the coal position was investigated. Mr. A. G. Watkins (local coal officer) presided and was supported by Mr. G. B. Dobell (clerk to the Urban Council) and Mr. E. Bryan (Coal Emergency Officer for S.W. Cornwall). It was reported by the Coal Emergency Officer that the question of immediate supplies was a serious one and that the stocks of coal in the district were exceedingly low. Such supplies as were available were at a very high figure, it being stated that the latest consignments of foreign coal were being sold to the merchant at 75s. per ton ex truck, which by the time it was carted to their stores cost up to 77s. 6d. The coal merchants expressed alarm at the failure of supplies and the price that they had now to pay for supplies.

Economic Pressure Telling

The order of the day in all the China Clay works is to work on the barest possible margin as regards labour costs, involving the cessation of employment on development work and the cutting down of surplus staffs formerly employed on production work. This stringent economic policy, dictated by the coal strike, is reacting upon the employment position in the China Clay areas of Cornwall and Devon, and is likely to add considerably to the number of unemployed. The functioning of the Association would have enabled the industry to face the situation with equanimity, but the outlook is now uncertain and the immediate future very depressing for all but the most prosperous firms.

The Visit of the Mineralogists

Elsewhere in this issue we give an account of the visit paid to the China Clay area by a party of mineralogists. The visit was made as part of the celebrations attending the jubilee of the Mineralogical Society of Great Britain. The party included Sir John Flett, Director of the British Geological Survey, and a number of other eminent mineralogists, both British and foreign. That such a group of eminent scientific men should include the district in their itinerary is a remarkable testimony to the many interesting features presented by it. To those from abroad the visit must have been especially interesting. Unique though the China Clay area is, we in England do not exhibit a very great curiosity about it, perhaps because it is our habit to accept blessings as a matter of course. The outstanding qualities of British China Clay must, however, have invested the visit with great importance in the eyes of delegates from countries which have industries dependent on supplies of this important product.

The visit further indicated the important part which has been played in British mineralogy and geology by workers from the West Country. For many years a band of enthusiastic workers have carried on investigations in this area. In some measure they have been fortunate in having at their doors a district which is very rich in unusual characteristics, but they are to be congratulated on the ardour with which their work has been carried on.

Canadian Virgin China Clay

(From a Correspondent)

CANADIAN papers continue to enlarge upon the commercial potentialities of the deposits of kaolin in Northern Ontario, and the prospects of their being developed on a scale to compete with English China Clay. We ourselves have no fear—even if the claims made for the quality of the deposits are justified in making them comparable with those of Cornwall and Devon—that they are likely seriously to menace our markets even in America or Canada. The transportation difficulty alone in the colony is a formidable one, for the nearest railway is at least 40 miles from the deposits, which even then are a very great distance from the great industrial centres of Canada and America.

The Railway Position

The suggestion is made by a writer in the *Toronto Star* that a chinaware city might eventually arise in the midst of what is described as a versatile mineral area. Here are some of his observations:

"The extension of the Temiskaming and Northern Ontario Railway northerly from Cochrane has now reached a point about 40 miles from the deposits of kaolin on the Mattagami River, and it is proposed to deflect the line of the railway sufficiently westward to touch the clay deposits. In this way will become accessible raw materials that may be made the foundation of a very large Canadian industry. In forming an estimate of the probable future value of the large territory extending from the National Transcontinental Railway northward to James Bay, one must discard the common conception of a land frozen, inhospitable, and uninhabitable except by Indians, trappers, and other hardy rovers. The mean average temperature at Moose Factory on James Bay is only a few degrees lower than that at Calgary, and the average temperature of the summer months is actually higher at Moose Factory.

"In mineral wealth this vast region has the largest possibilities. While the clay belt with its great depth of soil is not favourable to prospecting, the rock appears at the surface in places and gives the prospector his chance. In fact, this territory, like that further south, including the Porcupine, Kirkland Lake, and other productive mineral areas, is a judicious mixture of agricultural and mineral lands, capable of supporting a large population devoted to both of these basic industries.

"The discovery of China Blue Clay on the Mattagami and Missinaibi rivers merits special mention. The clay is in large quantities, and that on the Mattagami is of the best quality, while the Missinaibi clay has also been favourably reported on. This Northern Ontario kaolin may be made the foundation of a large and expanding industry, bringing in other raw materials and contributing to other Canadian industries in ways that merit careful attention and a far-sighted policy.

Forty-five-Year Old Discovery

"While there are clay deposits of some importance on the Missinaibi River, the clay of finest quality suitable for the manufacture of chinaware is to be found on the Mattagami. Four materials go into a piece of white chinaware: (1) China Clay; (2) Ball Clay; (3) flint, or its equivalent in pure white sand; and (4) feldspar. The first of these requisites—China Clay—is found in the large deposits on the Mattagami River, where it occurs between the old pre-Cambrian rocks and the flat beds of the limestone that begin between 90 and 100 miles north of the Cochrane and continue to James Bay. The presence of a clay deposit up north has been a matter of record in Ontario Government reports since 1881. In the previous year E. B. Barron, of Sault Ste. Marie, made a reconnaissance trip to Moose Factory, taking the Missinaibi River route. He noticed the clay, took a sample, and had it tested in Toronto University. It was then reported as 'nearly, if not quite equal to the Cornish Clay used in the manufacture of English porcelain.' This report of 45 years ago was filed away and forgotten. The Missinaibi River was beyond reach, almost beyond ken, but the deposit was further noticed in 1903 by J. Mackintosh Bell; and eight years later H. Curran and W. T. Calkins, of Montreal, staked a considerable area.

"In 1916 C. M. McCarthy, of Elk Lake, in a journey up the Mattagami River from James Bay, noticed clay of a different colour and quality from the usual glacial clay; and, having learned that the clay was of fine quality, he returned next year and staked claims. The building of the National Transcontinental and the Ontario Government Railway (T. and N.O.) had brought the clay deposits within about 100 miles of railway transportation. The extension of the T. and N.O. northward from Cochrane about halfway to the clay, and the probability that this railway will take a course so as to close the gap, has so stimulated enterprise that the Mattagami deposits have been re-examined with some degree of thoroughness and preparations made to exploit them. There seems to be no reasonable doubt as to the quantity of clay available.

Ball Clay Beds

"One of the clay beds on the Mattagami is of the quality called Ball Clay, used as a binding material in the manufacture of chinaware. It has been pronounced of good quality by the Government experts of clay. This is the first Ball Clay discovered in Canada. Pure silica sand, a third requisite in the manufacture of chinaware, is found plentifully in close association with the clay. This sand is exceptionally pure, analysing 99.8 per cent. silica. The fourth material, feldspar, used both in improving the body of the dishes and in putting on the glaze, is produced in large quantities in Ontario and Quebec. It seems that there is a good chance of finding it not far from the clay deposits. If feldspar of the best quality is found in the rocks a little further south all the materials required to start the manufacture of chinaware will be available within a small compass.

"But the good gifts do not stop at that point. Fire clay of the best quality is abundant. This will be required for lining the kilns and for other parts of the necessary apparatus. The rather constant association of fire clay with seams of coal in Great Britain is interesting in view of the reported discovery of coal under the Mattagami clay beds. But fire clay is needed for many other purposes, such as lining the furnaces used in the manufacture of steel, and making retorts, crucibles, sanitary ware, etc.

"One has a vision of a populous manufacturing city growing up in Northern Ontario, utilising the resources so generously provided there to make chinaware and paper, not only for Canada, but for export trade. In following out the wise policy of manufacturing our own raw material, it may be well to consider the advisability of bringing over from England the skilled workmen in clay who will be needed to carry on a chinaware industry. It is too soon to plan details, but it may be pointed out that contentment is a large factor in the success of an industrial organisation. This feature and the necessary skill could be secured at one blow by bringing in compact communities from the pottery districts of England."

Home Producers' Attitude

We have given this somewhat extensive survey of the position, as visualised by the Canadian propagandist, for the benefit of our home producers of China Clay, which is made accessible to the markets of the world at such low prices on account of its proximity to the sea-board. If the home industry was faced with the handicap of the heavy railway transportation costs with which the development of the China Clay deposits of Northern Ontario is faced, owing to their remoteness from the big markets, English China Clay producers would be unable to compete with the domestic clays of foreign countries. This inestimable factor in the dispatch of English China Clays—short railway transport between the China Clay works and ports—is one that exploiters of overseas kaolins do not sufficiently realise when they speak of ousting us from our export markets. While home China Clay producers are not disposed to adopt an ostrich-like attitude towards threatened exploitation of overseas deposits such as these in Northern Ontario, they are prepared to meet competition as they have met it in the past and are meeting it to-day, by placing their produce on the markets at as low a price as is compatible with quality and a fair margin of profit.

Mineralogists in Clay Area

Celebration of Society's Jubilee

THE Mineralogical Society of Great Britain celebrated its jubilee during the third week in September, when a party of eminent British and foreign mineralogists made a tour of Devon and Cornwall. One day was reserved for their visit to the quarries in the China Clay area, which always has such a fascination for geologists and mineralogists on account of its wealth and variety, especially in China Clay and China Stone.

The party was in charge of Mr. Arthur Russell, of Swallowfield Park, who, like his forbears, has made an intimate study of Cornish minerals and possesses one of the finest and most complete collections of minerals in the world. He was accompanied by his brother, Sir James Russell, Bart., and Captain Puckle, a well-known collector of minerals. The party included Sir John Flett, Director of the British Geological Survey; Dr. T. L. Walker, Professor of Mineralogy at the Royal Museum, Ontario, Canada, and his son, Mr. James Walker; Mr. Campbell Smith, of the Mineralogical Department of the British Museum; Professor R. L. Parker, lecturer in mineralogy at the University of Zurich, Switzerland; Dr.

augmented by the presence of Sir John Flett, of the British Geological Survey, whose knowledge of the district from a geological point of view is extensive. The party started from Truro, where they arrived the previous night after inspecting the mineral formations in West Devon and North Cornwall, and were met at St. Stephens Churchtown by the party from St. Austell. They proceeded to Tregargus China Stone quarry, belonging to Olver and Co., Ltd., and made an inspection of the various qualities of China Stone produced there and at other quarries, namely, hard purple, mild purple, and white and buff. Later they viewed the stone quarries of English China Clays, Ltd., at Hendra.

At Tregargus Mr. Boxhall described the Hensbarrow granite massif, and also dealt with China Stone, which is quarried in the neighbourhood. The stone grinding mills, worked by water power, at Tregargus were inspected. Here, after the stone has been crushed into small knobs, it is ground to powder by the action of slabs of China Stone prepared for the purpose, the object being to eliminate the possibility of any foreign substances lessening the purity of the ground stone.



THE MINERALOGISTS' PARTY IN THE CHINA CLAY AREA.

Leon H. Borgstrom, Helsingfors, Finland; Msr. S. Tomkeieff, Director of Mineralogy at Armstrong College, Newcastle-on-Tyne; Dr. Julien Drugman, of Brussels; Mr. James Broadhead, of Darlington; Dr. Herman Steinmetz, Professor of Mineralogy, Munich, Germany; Professor Grossnen, Director of the Mineral Institute of the University of Munich, Germany; W. Maucher, mining engineer and mineralogist of Munich; Mr. E. H. Davison, Geological Department, School of Mines, Camborne; Señor Joaquin Folchy Girona, lead mines manager, of Barcelona, Spain; Msr. Henry Buschor, and Professor Heinrich Heertz, of Baden, Germany. Mr. W. Boxhall, of St. Austell, a well-known authority on the geology of the district and the possessor of one of the most complete collections of minerals, made the local arrangements on behalf of the Society and acted as guide of the party throughout the day's itinerary.

China Clay Firm's Interest

Much of the success of the day's outing was due to the interest taken in the party by English China Clays, Ltd., whose works manager, Mr. A. Davies, explained the working of the China Stone quarries and China Clay mines, Mr. Boxhall describing the history and geological formation of the minerals inspected. The interest of the visit was greatly

China Clay Pits Inspected

The party then set off for the pits and works of English China Clays, Ltd., at Hendra, St. Dennis. Mr. Davies first showed the company the micas and settling pits in connection with the old Hendra pit, which is of great historic interest, because it was here that the famous Cookworthy, the discoverer of China Clay for the manufacture of china, worked the first clay 130 years ago. The party then proceeded to Hendra new pit, in connection with the working of which the latest processes are in operation. At the power station is housed the latest electrical machinery which provides the power for the pumps, the inclines, the hydraulic hoses, and the air compressors at the adjoining stone quarries, besides providing light. Here, Mr. Davies said, was the first pit in which centrifugal pumps were introduced by the company, it having also the distinction of being the first works to use the filter press system in connection with the drying of China Clay. English China Clays, Ltd., have largely extended the system, which they have proved on a commercial scale to be very economical. The water in the clay as it comes from the tanks is squeezed out by the presses, the slabs being then deposited on the drying pan of the kiln by means of an electrical travelling platform from which they slide by means of a tilting device.

The party afterwards proceeded to the offices of the company at Drinnick Mill, Nanpean, where they were entertained to luncheon, and met Mr. R. Large, one of the directors of English China Clays, Ltd., who presided. Mr. Arthur Russell, on behalf of the party, expressed their high appreciation of the company's hospitality, and said how delighted they had been at what they had seen and how impressed they were by the magnitude of the company's operations and the high quality of the clays they produced. Mr. Large said the company felt amply compensated by the fact that they had been able to show the party something that interested them.

Hensbarrow Area

The party next paid a visit to the Dorothy pit of English China Clays, Ltd., in St. Stephens Parish, where some of the best paper and bleaching clays in the industry are produced. The party were greatly impressed by its richness and by the presence of a blue lode which accounts for the purity and whiteness of the clay produced there. Mr. Boxhall explained that China Clay is obtained from highly decomposed granite and consists of the disintegrated and chemically altered felspar of that rock. The washing process consisted merely of separating the kaolin from the quartz and tourmaline, and refining it by its being carried in suspension over mica dries in which the coarse material remained while the clay passed on to the settling pits and tanks and was later dried. The next stop was at Hensbarrow Beacon. Mr. Boxhall said the mound was generally accepted as of Roman origin, and was a camp and place of observation. From it could be seen both channels, north and south, and a large part of the county, including the whole area of the Hensbarrow China Clay system.

On arrival at Roche Rocks, the party clambered to the top of the rock, on which are the ruins of the ancient hermitage, said to date back 700 years. Mr. Boxhall said they were now looking at the rugged mass of Schorl rock, known as the Roche Rock. It was composed of tourmaline and quartz. The tourmaline is of secondary origin and occurred as a metasomatic replacement of mica and felspar. Near by the rock some kaolin had been dug up and the presence of the kaolin there seemed to corroborate the assumption that the rock mass was formed by a tourmalisation of a granite apophysis, the surrounding rock having been subsequently worn away by erosion. A visit was finally made to William Varcoe and Sons' Felspar Quarry at Trezaise, Roche, from which several thousands of tons were quarried during the war when it was difficult for foreign supplies to be obtained for the purpose of making clinical, surgical, and optical glasses needed by the nation. Some felspar is still being obtained from the quarry. The party returned to Truro via St. Austell and on the way stopped at John Lovering and Co.'s Lower Ninestones works, where a typical Cornish pumping engine was inspected. Before leaving the party cordially thanked Mr. Boxhall and Mr. Davies for their excellent arrangements for the day's itinerary.

Future Rating of Machinery

Important to China Clay Companies

IN the course of an address to the rating authorities at St. Austell on the new Rating and Valuation Act, which comes into operation in April next, Mr. F. H. Smith, late Clerk to the St. Austell Guardians and Rural District Council, made the following references to the rating of machinery, which should prove of considerable interest to China Clay companies and others using machinery.

One class of property had in the past caused no little anxiety to those engaged in rating and valuation work. He referred to the valuation of hereditaments containing machinery and plant.

In the long line of cases which had been decided on the point, while certain principles of law had been established, no measure of uniformity had been secured by assessment authorities, and the result was that to-day in some areas users of machinery and plant were rated up to the hilt while in others the valuations had been effected with much greater leniency.

Under the new Act—section 24—the difficulties which had arisen in determining what machinery and plant should be excluded from an assessment were removed and it will be possible

to make the new valuation with very little, if any, uncertainty as to the particular subject matter which was to be taken into account as forming part of the hereditament.

Schedule III of the Act contained a general description of the several classes of machinery and plant which were to be deemed part of the hereditament in which they were placed, and in arriving at the valuation, no account was to be taken of any other machinery and plant which might be on the hereditament.

The classes included in the schedule appeared for the most part to comprise such subject matter as might reasonably be considered part of the general furnishing necessary for any hereditament which was to be occupied for factory purposes and to exclude such additional equipment as might be required to adapt the hereditaments for a particular industry.

It will not, however, be left to rating authorities, assessment committees, or even appeal tribunals to interpret the language used in the schedule, for provision is made in section 24 for the appointment by the Ministry of Health of a Committee of five members, whose duty it will be to prepare a detailed statement showing all the machinery and plant which falls within the several classes specified.

Pottery Industry Revolution

Possibility of Oil Fuel Ovens

WE have always been told that the particular advantage which the Potteries have over Cornwall and Devon in the making of pottery is the nearness of the coal supply which is necessary for the ovens, writes a correspondent. Now for the first time in the history of British pottery, ovens are being successfully fired there by oil fuel. A message from the Hanley correspondent of *The Times* says that this development may revolutionise the whole methods of pottery firing. The pioneer is Major G. A. Wade of the Manchester Pottery, Burslem, who, beginning his experiments in the 1921 coal strike, "has now fired 20 ovens under normal commercial conditions with complete success, so much that he says that his firm will not return to coal firing. Major Wade has freely communicated the results of his experiments to other pottery manufacturers, and four other firms are now also firing with oil." The correspondent was shown "detailed records and statistics, proving that with oil firing the wares are fired more uniformly, and with approximately half the loss in spoilt wares entailed by coal firing. In addition, wear and tear on the ovens is reduced to a minimum. The cost of the oil fuel is less than coal at its present high price, but more than coal at its pre-strike price, but Major Wade is confident that he will be able to reduce oil fuel costs still further."

Have we not material in this for serious thought and a consideration of the whole question of pottery making in Plymouth or St. Austell, close to the doors of which China Clay is produced? I know that there is now a small industry at Plymouth in which pottery is fired by gas, but I do not know how the cost compares with that of coal fuel or oil, or whether gas is suitable for firing on a large scale, but apparently gas in the Potteries has not entered into competition there with coal.

China Clay Association Collapse

THE new all-in China Clay Association, which was registered last month under the title of Associated China Clays, Ltd., has ceased to exist. The announcement of the failure to obtain the assent of a sufficient number of members to make the new Association effective came as a great surprise to the China Clay areas, when the following brief bulletin of the Executive Committee (chairman, Mr. E. J. Hancock; secretary, Mr. A. J. Perry) was issued to the trade:

"The Committee regret to report that their efforts to form a new China Clay Association have proved unsuccessful. As an insufficient number of agreements have been signed and returned it has been considered impossible to proceed with the proposed new association."

Hard upon this announcement came the following circular from Mr. S. Benson, secretary of the company: "Your Board of Directors regret to inform you that, in consequence of a sufficient number of agreements not having been received, they have decided to recommend that the necessary steps be taken to wind up the company."

China Clay Notes and News

China Clay Firm's Director's Resignation

The announcement is made that Mr. A. Courtney, who has been the managing director of Great Treverbyn and Ruddell Common China Clay Co.'s since their inception, has resigned his directorships of both companies.

China Clay Manager's Death

Captain W. Martyn, who died at St. Stephens on September 30, was an employee at the Burthy China Clay works, where he had been under various companies for 40 years, and the high esteem in which he was held was manifest by the large number who attended the funeral. He leaves a widow and six children. Messrs. A. J. Perry and S. B. Perry represented the directors of the Burthy China Clay Co. at the funeral, and many of the men from the works also attended.

Presentation to China Clay Captain

Captain D. Roberts, who has been in charge of Messrs. Spicers' Carpalla China Clay works at St. Stephens for the past fifteen years, and who has now resigned and taken a similar post with a neighbouring company, has been the recipient of a farewell present, in the form of a clock, from the workmen. After the presentation had been made, Capt. Roberts expressed his appreciation to those present, and also to those who had found it impossible to attend, for contributing towards the present, which would serve to remind him of the many happy days he had spent with them.

Editor's Views of China Clay Association Collapse

"I have not sufficient inside knowledge to know all the circumstances bringing about the collapse of the proposed new China Clay Association and don't even know the names of the firm or firms responsible for this collapse," writes the editor of the *Cornish Guardian*. "On the face of it, however, it looks as if an unfortunate mistake has been made, and the first to be hit will be those that are least able to stand it. The wealthy and prosperous China Clay companies can look after themselves, but it will not be so easy for those not so fortunately placed. As regards places where there is over-production of a commodity on the markets I am far more concerned in this matter about the possible consequences to the clay-worker than I am about the clay producer. The producer is in a better position to look after himself, though he may have to suffer if over-production involves a price which returns no profit. But it is the clayworker who stands to lose most if the industry is not prospering, as wages are adversely affected. One can only hope that the result of the breakdown will not be so bad as some may fear. If industry generally would revive, then the demands for the China Clay might increase concurrently with it. It is, at any rate, a situation in which patience is needed all round."

The Anomalous Flocculation of Clay

A short time ago some notes on a recent discussion on the anomalous flocculation of clay were published in this review. A further contribution to the discussion has been made by Dr. N. M. Comber, in a letter to *Nature* (September 18), in which he says: "In a letter to *Nature* of May 1 Dr. Joseph and Mr. Oakley allude to some experiments which have convinced them that the alleged anomalous flocculation of clay does not exist. The anomalous flocculation of clay is said by them to be the accelerating influence of hydroxyl ions on flocculation by calcium salts when compared with the retarding effect of hydroxyl ions on flocculation by sodium salts. I should like to submit, however, that the behaviour of calcium ions in alkaline medium is not regarded as anomalous by comparison with the behaviour of sodium ions in alkaline medium. Flocculation of clay by calcium salts is anomalous when considered in the light of prevalent theories, and not necessarily when compared with the behaviour of other ions. As I understand the anomalous flocculation of clay, the most that could be claimed by Dr. Joseph and Mr. Oakley is that the sodium flocculation of clay is also anomalous. One realises, of course, that within the limits of a letter a description of experimental detail is not possible, but it is crucially important to know what precisely is meant by a 'highly purified clay.' The significance of the results in question is entirely dependent upon the complete removal

of both adventitious and absorbed calcium in the clay. A highly purified clay suspension would ordinarily be taken to mean a suspension of clay in which there was no appreciable amount of the coarser particles, but such a clay suspension would still contain absorbed calcium, and on the addition of sodium salts that calcium would come into solution. Soils containing absorbed calcium can ordinarily be flocculated by the addition of a sufficient amount of alkali, but according to some incidental observations made on soil suspensions in these laboratories, by S. J. Saint (*Proc. 2nd Comm. Intern. Soc. of Soil Science*), when the absorbed calcium has been completely replaced by sodium, no amount of sodium hydroxide will bring about a flocculating effect."

English China Clays Offices Fire

A serious fire broke out at St. Austell on October 6, involving the roof of the large block of offices of English China Clays, Ltd., and in a short time slates were dislocated and were falling to the danger of the people near. From the roof of the English China Clays' garage—a building apart from the offices—and also from the post office yard, the brigade poured great volumes of water on the flames, while other members of the brigade were inside taking their hose up the stairs, playing at close quarters on the fire, which they succeeded in confining to the top storey.

The departments involved on the top storey were the works manager's office, a typists' room, the telephone exchange, and two laboratories. The brigade were assisted by a number of volunteer workers, and also by some of the chief officials of the company, including Mr. Henry Stocker, a director, Mr. H. S. Andrew, secretary of the company, and Mr. G. H. Grenfell, who were helped by members of the staff. Shortly after seven the brigade had got the fire completely under control, and by 7.30, after dealing with isolated outbreaks, succeeded in extinguishing it. Through the rapidity with which the fire was got under control, fortunately much of the furniture and equipment in the rooms mentioned were saved, including several typewriters, telephone exchange switchboard, valuable chemical balances, and other apparatus and papers. Extensive damage has been done to the upper storey of the building by fire as well as through the action of the water that had to be poured on the flames, the ceiling and parts of the wall giving way.

Although the damage is confined to the top storey, the floors right down through the building suffered damage as the result of the water flowing down. Fortunately, the confidential papers and documents belonging to the company are stored in a strong room in the lower part of the building and have escaped damage. The managing director (Mr. T. Medland Stocker) was abroad, and the works manager (Mr. Alf. Davies) was in London. The extent of the damage amounts to several hundreds of pounds, the necessary restoration including a new roof. The sales organisation of the company has not been interfered with, the staff being in a position to carry on the next day. The cause of the outbreak is uncertain, though the suggestion has been made that it was due to the fusing of an electric light wire.

Georgia Clays: Purification and Uses

A paper entitled "Beneficiation and Utilisation of Georgia Clays," by R. T. Stull and G. A. Bole, has been issued as Bulletin 252 of the U.S. Bureau of Mines. As a result of investigation it is stated that Georgia clays, properly mined, refined, and blended, could be utilised in the manufacture of chinaware, tiling, high-grade refractories, and ornamental face brick, and, to some extent, could be used to displace clays previously imported into the United States. The State of Georgia contains large areas of sedimentary kaolins and bauxites of industrial importance. Considerable development has taken place, and many undeveloped deposits are available. Georgian kaolins have heretofore been used to some extent in the several white-ware industries. They have been used in virtually every type of pottery body, both dry press and plastic, where a China Clay is required. In some cases they have been used successfully, while in others their use has been discontinued because of various reasons. Their use has been abandoned by some chinaware manufacturers, principally because of lack of uniformity. Many of the clays burn to a

good white, while others burn to a cream colour. Georgia clays have been used extensively in the sanitary tile and electrical porcelain industries, but some manufacturers of these wares have not made use of them because black specks developed during the firing.

The Bureau of Mines investigators state that, by the use of proper washing methods, the Georgia clays could be washed free from material causing dark specks in whiteware. It was found that many clays which burned to an undesirable cream colour could be produced white enough to meet requirements if proper care were taken in their mining and refining. A serious problem in connection with the use of sedimentary clays in white ware is the high bisque loss and excessive shrinkage. These difficulties could, it is thought, be largely overcome by proper body mixes and by the blending of the clays.

Copies of the paper may be obtained from the Superintendent of Documents, Washington, D.C., at a price of 20 cents.

Fowey Water Revenue

It was reported by the Clerk, Mr. H. S. Graham, at the last Fowey Council meeting, that the Jetty Revenue for August had been £110 17s. 6d. Speaking on the water position in Fowey, Councillor George Varcoe, Junr., the Chairman of the water committee, said that the revenue for the jetties had increased considerably. In August, 1925, the revenue was just over £48, but this year it amounted to £110, an increase of £62.

China Clay Company's Rates

On a China Clay company being summoned for the non-payment of rates at St. Austell Petty Sessions, Mr. J. Couch stated on behalf of the company that in consequence of the coal strike and other causes they had been unable to pay their rates, and asked for an adjournment for a month.—The Bench intimated that they had not the power to do that, but arrangements could be made with the overseers. The Bench made the order.

Memorial to Doctor China Clay Merchant

The harvest thanksgiving service at St. Austell Parish Church was made the occasion of the dedication of the latest stained-glass window to be given to the church—a very beautiful memorial to the late Dr. Rd. Fred. Stephens and family, of St. Austell. The window has been placed in the church through the gift of Mr. W. J. Adams, of "Methleigh," St. Austell. The Stephens memorial window occupies a position in the north wall, next to the recently dedicated Lovering memorial window, and is architecturally the best window in the church.

Young Clay Merchant's Death

The death of Mr. Richard John Wedlake, of Aurora Terrace, Mount Charles, at the age of 26, has come as a shock to his many friends in St. Austell district. He commenced his career as a youth in the Capital and Counties Bank at Falmouth and was later transferred to a branch in the neighbourhood of Guildford. As soon as he was eligible for service he joined up and in the later stages of the war was on active service in Italy. On being demobilised, he returned home and joined his father in the latter's China Clay business. In this capacity he proved himself a very capable business man and a trustworthy assistant to his father. There was a large and representative attendance at the funeral.

Fowey Freedom on Former Mayor

The Mayor introduced a subject of great interest to the borough in referring to the valuable services of Mr. Simeon Rowe, of Fowey, at the last Fowey Council meeting. He thought it right that Mr. Rowe's departure from the town should be marked by some testimony from them, and he had decided, with the Council's approval, to confer on Mr. Rowe the Freedom of the Borough of Fowey. His Worship then moved in the following terms: "That Simeon Rowe, in 1922-23 Mayor of Fowey and previously in succession Councillor and Alderman, be admitted an honorary freeman of the borough in recognition of his private and public worth, his lifelong loyalty to his native town, and in particular his vigilant charity towards all sick persons and young children, of a man, in brief, who through many years proud of Fowey's past, yet strove to leave his birthplace even better than he found it."

Death of China Clay Company's Manager

We regret to record the death of Mr. W. Mutton, who died at Alynbank, Watering Hill, St. Austell, last month, at the age of 76. His wife's death occurred a fortnight before his own. Until a year ago Mr. Mutton had resided and worked for 40 years at Charlestown, where he was one of John Lovering and Co.'s most trusted and reliable managers, and superintended their shipping operations. As a youth he worked in the China Clay works, and as a result of his own industry rose to a position of responsibility in the China Clay trade. At a recent function in St. Austell he related how as a young man he built his own house in which he went to live when he was married. He recommended all young men who wanted to make progress in life to rely on their own efforts. He was responsible for the introduction, in co-operation with Mr. Jewell, of the travelling platform into the China Clay dries, from which the wet clay is tipped on to the drying pan.

Lord Falmouth on China Clay Trade

Speaking at a luncheon at St. Dennis (in the heart of the China Clay district) recently, in connection with the opening of the extension to the War Memorial Institute, the ceremony in connection with which was performed by Lady Falmouth, Lord Falmouth, who is a large owner of clay-bearing lands worked by various China Clay firms, said while the best grades of China Clay sold themselves, there was difficulty in selling the poorer qualities. They hoped that was only temporary, and that the poorer classes would soon find a ready market. People must have China Clay, and in the industrial system China Clay played a very important part, and one could judge the civilisation of a nation by the amount of Cornish China Clay it imported.

Lord Falmouth said he did feel that the China Clay industry was to be congratulated upon the excellent relations that had existed between the masters and the men throughout the most trying period of price-adjustment since the war. In other parts of the country they had seen what difficulties had followed upon an unsympathetic spirit, and they only hoped other industries would come down to Cornwall and take a leaf out of the book there. Masters and men had learnt to appreciate each other's point of view, and had seen that only by pulling together could they hope to make a great industry prosperous.

Lord Falmouth gave the land on which the institute was built in 1922-23. The chairman of the institute committee is Mr. R. Hooper, manager of H. D. Pochin and Co.'s works, and China Clay "Captains" and workmen are closely associated with the working of the institute, which is now claimed to be the best of its kind in Cornwall.

September Delivery Improvement

While the deliveries of China Clay in August showed a drop of 14,000 tons from the July figures, those for September show an increase of 10,000 tons on the August figures. Six thousand tons of the increase were cleared through Fowey. China stone showed an increase of 2,200 tons, but Ball Clay showed a decrease of 1,200 tons. There was a net increase in the total deliveries in all classes of 10,105 tons.

Taking the figures for the nine months there is an increase in China Clay deliveries of about 9,000 tons compared with the corresponding nine months last year, a decrease of over 3,000 tons in those of China Stone, and a decrease of over 1,000 tons in those of Ball Clay. On the total turnover of business done in the nine months, there is an increase of nearly 4,000 tons in favour of this year, which, considering the drawbacks of the industrial conditions this year, is eminently satisfactory.

The following are the details of the September deliveries:

Port.	China Clay. Tons.		China Stone. Tons.		Ball Clay. Tons.		Total. Tons.	
	1926	1925	1926	1925	1926	1925	1926	1925
Fowey ...	62,305	60,316	3,548	3,494	2,194	2,015	68,047	65,825
Charlestown	4,827	5,821	—	—	—	—	4,827	5,821
Par	4,547	5,488	—	—	—	—	4,547	5,488
Plymouth ..	645	920	29	—	—	—	674	920
Penzance ..	464	—	—	—	—	—	464	—
Falmouth ..	—	—	—	—	120	—	120	—
Looe	—	154	—	—	—	—	—	154
By rail	4,571	4,529	—	—	—	—	4,571	4,529
September	77,350	77,228	3,577	3,494	2,314	2,015	83,250	82,737
8 months ..	587,985	579,302	26,786	30,444	15,127	16,619	629,898	626,365
9 months ..	665,344	656,530	30,363	33,938	17,441	18,634	713,148	709,102

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—September, 1926

Arrived.	Name.	Sailed.	Destination.
September	1, M.V. <i>Raymonde Naval</i>	September	4, Harburg
September	1, S.S. <i>Hillbrook</i>	September	4, Montreal
September	1, S.S. <i>Leelite</i>	September	3, Methil
September	1, S.S. <i>Blackwater</i>	September	7, Ghent
September	1, M.V. <i>Drogden</i>	September	6, Castellamare
September	2, S.S. <i>Mersey</i>	September	6, Riddham
September	2, M.V. <i>Gaelic</i>	September	8, Weston Point
September	2, S.S. <i>Westerham</i>	September	7, Leith
September	3, S.S. <i>Glenageary</i>	September	7, Weston Point
September	3, <i>Sverre</i>	September	14, Raumo
September	3, S.S. <i>Malrix</i>	September	10, Emden
September	5, S.S. <i>River Fisher</i>	September	10, Antwerp
September	5, S.S. <i>Afon Gwili</i>	September	9, Brussels
September	6, S.S. <i>Ruyssdael</i>	September	14, Portland, Me.
September	6, S.S. <i>Pansy</i>	September	18, Fleetwood
September	7, S.S. <i>Dorset Coast</i>	September	10, Liverpool
September	7, S.S. <i>Palmaria</i>	September	10, Genoa
September	7, S.S. <i>Dickie</i>	September	7, Par
September	8, S.S. <i>Marta</i>	September	11, Wargon
September	9, S.S. <i>Victoria Maru</i>	September	18, Boston and New York
September	9, S.S. <i>Kenrix</i>	September	16, Bremen
September	9, M.V. <i>Karnten</i>	September	14, Hamburg
September	10, S.S. <i>Isbjorn</i>	September	10, Emden
September	10, <i>R. Passmore</i>	September	25, London
September	10, S.S. <i>Brookside</i>	September	10, Rouen
September	11, S.S. <i>Dorrien Rose</i>	September	17, Runcorn
September	11, S.S. <i>Ferndene</i>	September	15, Antwerp
September	11, S.S. <i>Alice</i>	September	16, Barrow
September	12, S.S. <i>Avanville</i>	September	16, Runcorn
September	12, S.S. <i>Joffre Rose</i>	September	22, Bruges
September	12, M.V. <i>Kongedybet</i>	September	17, Raumo
September	12, S.S. <i>Sambre</i>	September	18, Pasages
September	13, M.V. <i>Wirumaa</i>	September	21, Kotka
September	14, M.V. <i>Mayblossom</i>	September	15, Looe
September	15, S.S. <i>Ravenspoint</i>	September	17, Genoa
September	15, S.S. <i>Merwede</i>	September	21, Antwerp
September	16, S.S. <i>Blush Rose</i>	September	22, Weston Point
September	16, S.S. <i>Farfield</i>	September	21, Liverpool
September	16, M.V. <i>Mayblossom</i>	September	16, Plymouth
September	17, S.S. <i>Patrick</i>	September	24, Hamburg
September	17, S.S. <i>Mersey</i>	October	1, Riddham
September	17, S.S. <i>Castlerock</i>	September	20, Pentewan
September	17, S.S. <i>Guelder Rose</i>	September	22, Weston Point
September	17, S.S. <i>Primrose</i>	September	24, Runcorn
September	17, S.S. <i>Gronant Rose</i>	September	21, Preston
September	18, S.S. <i>Raylight</i>	September	Antwerp
September	18, S.S. <i>Monkstone</i>	September	21, Brussels
September	19, <i>Woitja</i>	October	2, Raumo
September	19, M.V. <i>Pacific</i>	September	29, London
September	19, <i>Matilda</i>	September	21, Pentewan
September	19, M.V. <i>Agathe</i>	September	22, Aberdeen
September	19, S.S. <i>Nestlea</i>	September	26, Philadelphia
September	19, <i>Active</i>	October	5, Aviles
September	19, M.V. <i>Steiermark</i>	September	23, Hamburg
September	20, S.S. <i>Glenageary</i>	September	24, Runcorn
September	20, S.S. <i>Maria Christina</i>	September	29, Portland, Me.
September	20, <i>Alzina</i>	September	24, Plymouth
September	20, S.S. <i>Dorset Coast</i>	September	23, Liverpool
September	20, <i>Buttercup</i>	October	1, Gravelines
September	22, S.S. <i>Clydeburn</i>	September	28, Antwerp
September	22, S.S. <i>Alessandro</i>	September	30, Genoa
September	22, S.S. <i>Yewglen</i>	September	29, Rouen
September	23, S.S. <i>Horn</i>	September	25, Rouen
September	23, S.S. <i>Shoreham</i>	September	28, Weston Point
September	23, M.V. <i>Zeehond</i>	September	29, Leith
September	24, M.V. <i>Mary B. Mitchell</i>	September	29, Rochester
September	25, M.V. <i>Lydia Cardell</i>	October	2, Hull
September	25, S.S. <i>Pansy</i>	September	29, Riddham
September	25, S.S. <i>Sturdee Rose</i>	October	3, Dublin
September	26, S.S. <i>Snofrid</i>	*	Rotterdam
September	27, M.V. <i>Nordo</i>	October	2, Reval
September	29, S.S. <i>Eastlea</i>	*	Portland, Me.
September	29, S.S. <i>Ciscar</i>	October	1, Genoa
September	29, M.V. <i>Alzina</i>	October	1, Pentewan
September	30, S.S. <i>Horn</i>	October	5, Pasages
September	30, S.S. <i>Guelder Rose</i>	October	4, Weston Point
September	30, S.S. <i>Dorrien Rose</i>	October	4, Preston

* "In Port."

Charlestown Shipping—September, 1926

Date	Vessel.	From	Sailed,
September	2... S.S. <i>Porthcarrack</i>	Brugge	Sept. 9
September	3... <i>Isabella</i>	Falmouth	Sept. 6
September	7... S.S. <i>Multistone</i>	Truro	Sept. 8
September	7... <i>Henricella</i>	Porthoustock	Sept. 10
September	9... S.S. <i>Treleigh</i>	Barry	—
September	9... <i>Lynher</i>	Plymouth	—
September	10... S.S. <i>Porthleven</i>	Hayle	Sept. 10
September	10... <i>Shamrock</i>	La Pallice	—
September	10... M.V. <i>Frida Both</i>	Par	Sept. 13
September	11... <i>Walkyrie</i>	Morlaix	Sept. 13
September	16... S.S. <i>Admiral</i>	Portsmouth	Sept. 17
September	16... <i>Hope</i>	Porthoustock	—
September	18... <i>Pechouse</i>	Truro	Sept. 22
September	21... <i>Shortest Day</i>	Plymouth	—
September	22... <i>Alice Williams</i>	Penzance	Sept. 23
September	23... <i>Lady Rosebery</i>	Plymouth	Sept. 23
September	23... <i>Diligent</i>	Plymouth	—
September	23... S.S. <i>Fox</i>	Exmouth	Sept. 24
September	24... S.S. <i>Crossbill</i>	Truro	Sept. 25
September	24... S.S. <i>Reedness</i>	Poole	—
September	24... <i>Crown of Denmark</i>	Plymouth	Sept. 27
September	25... M.V. <i>Romantic</i>	Exeter	Sept. 27
September	26... S.S. <i>Porthleven</i>	Cardigan	Sept. 27
September	28... M.V. <i>Dietrich Hasseldieck</i>	Portsmouth	—
September	29... M.V. <i>Haldon</i>	Exeter	Sept. 30
September	29... M.V. <i>Haldon</i>	Exeter	Sept. 30
	<i>Donald and Doris</i>	—	Sept. 2
	<i>Danneborg</i>	—	Sept. 11

Par Harbour Shipping—September, 1926

Date.	Vessel.	From
September	1, M.V. <i>Anna</i>	Dartmouth
September	1, S.S. <i>Ruth</i>	Looe
September	2, M.V. <i>Kehdingen</i>	Truro
September	2, S.S. <i>Pegrix</i>	Exmouth
September	3, M.V. <i>Welcome</i>	Falmouth
September	4, S.V. <i>Lady Daphne</i>	Falmouth
September	4, M.V. <i>Frida Both</i>	Viborg
September	5, S.S. <i>Regina</i>	Terneuzen
September	6, S.S. <i>Porthmeor</i>	Terneuzen
September	7, M.V. <i>Dickie</i>	Hamburg
September	9, M.V. <i>Result</i>	Falmouth
September	10, M.V. <i>Guiding Star</i>	Falmouth
September	11, S.S. <i>Lillan</i>	Plymouth
September	11, S.S. <i>Robrix</i>	Teignmouth
September	12, S.S. <i>The Forester</i>	Barry
September	14, S.V. <i>Alf Everard</i>	Exeter
September	18, S.V. <i>Naiad</i>	Plymouth
September	18, S.S. <i>Slav</i>	Exeter
September	19, S.V. <i>S. F. Pearce</i>	Hayle
September	19, S.S. <i>Balmyle</i>	Terneuzen
September	19, S.S. <i>Wilhelmine</i>	Hamburg
September	22, S.S. <i>Castlerock</i>	Pentewan
September	24, M.V. <i>Haukur</i>	—
September	25, S.V. <i>J. N. R.</i>	Truro
September	30, M.V. <i>Hope</i>	Mevagissey

Date.	Vessel.	Destination.
September	1, S.S. <i>Leelite</i>	Fowey
September	2, S.S. <i>Norrix</i>	Gravesend
September	3, S.S. <i>Pegrix</i>	Ostend
September	4, M.V. <i>Romanie</i>	London
September	4, S.S. <i>Ruth</i>	Antwerp
September	6, M.V. <i>Kehdingen</i>	Gravesend
September	7, M.V. <i>Anna</i>	Antwerp
September	8, M.V. <i>Welcome</i>	Penarth
September	8, S.S. <i>Regina</i>	Jersey
September	10, S.S. <i>Lady Daphne</i>	Rochester
September	10, M.V. <i>Frida Both</i>	Charlestown
September	10, S.S. <i>Porthmeor</i>	Terneuzen
September	10, M.V. <i>Dickie</i>	Antwerp
September	13, S.S. <i>The Forester</i>	Poole
September	14, S.S. <i>Lillan</i>	Antwerp
September	14, S.S. <i>Robrix</i>	Gravesend
September	15, M.V. <i>Result</i>	Poole

September 16, s.v. Alf Everard	Rochester
September 20, s.v. Guiding Star	Queenborough
September 22, s.s. Stav	Rouen
September 23, s.v. Naiad	Rochester
September 23, s.s. Balmyle	Rochester
September 23, s.s. Wilhelmine	Terneuzen
September 24, s.s. Castlerock	Gravesend
September 27, s.v. S. F. Pearce	—

Par Harbour Tide Table, November, 1926

(Greenwich Mean Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Monday	1	2.24	2.52	10.7
Tuesday	2	3.18	3.39	11.4
Wednesday	3	3.59	4.17	12.0
Thursday	4	4.34	4.51	12.6
Friday	5	5.7	5.24	12.9
Saturday	6	5.40	5.56	12.10
Sunday	7	6.13	6.29	12.11
Monday	8	6.45	7.1	12.9
Tuesday	9	7.18	7.36	12.4
Wednesday	10	7.55	8.15	11.9
Thursday	11	8.36	8.59	11.1
Friday	12	9.26	9.58	10.5
Saturday	13	10.32	11.12	10.1
Sunday	14	11.55	—	10.2
Monday	15	0.38	1.18	10.11
Tuesday	16	1.55	2.29	11.10
Wednesday	17	2.59	3.26	12.9
Thursday	18	3.51	4.15	13.5
Friday	19	4.39	5.2	13.8
Saturday	20	5.24	5.46	13.9
Sunday	21	6.7	6.27	13.7
Monday	22	6.47	7.6	13.1
Tuesday	23	7.25	7.45	12.4
Wednesday	24	8.4	8.23	9.11
Thursday	25	8.43	9.4	10.8
Friday	26	9.27	9.53	9.11
Saturday	27	10.22	10.55	9.5
Sunday	28	11.32	—	9.3
Monday	29	0.10	0.47	9.7
Tuesday	30	1.21	1.53	10.2

E. CLEMENS, Harbour Master.

China Clay Exports for September, 1926

A RETURN showing the exports of China Clay, including Cornish or China Stone, the produce or manufacture of the United Kingdom from the United Kingdom to each country of destination registered during the month of September, 1926:

COUNTRY OF DESTINATION.	CHINA CLAY, INCLUDING CORNISH OR CHINA STONE.	
	QUANTITY.	VALUE.
	Tons.	£
Russia	380	606
Finland	2,771	4,621
Estonia	13	42
Sweden	1,686	3,064
Germany	1,819	4,052
Netherlands	3,668	8,236
Java	105	395
Belgium	5,482	8,987
France	2,148	4,141
Switzerland	21	51
Spain	852	2,333
Italy	4,066	10,178
Bulgaria	1	13
Turkey, Asiatic	10	54
United States of America	31,845	62,158
Mexico	272	1,118
Argentine Republic	210	867
Cape of Good Hope	1	8
Other Ports	950	3,828
Madras	30	126
Bengal, Assam, Bihar and Orissa	270	1,016
Hong Kong	—	1
Australia	46	263
New Zealand	1	5
Canada	169	573
	56,816	117,336

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

County Court Judgment

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for damages or otherwise, and the result of bona-fide contested actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors we do not report subsequent County Court judgments against him.]

AULT AND TUNNICLIFFE, LTD., Swadlincote, pottery manufacturers. £18 os. 6d. September 6.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

ENGLISH CHINA CLAYS, LTD., St. Austell. Registered September 21, mortgage securing yearly minimum rent of £16,650 and certain royalties, to J. B. Fortescue, Bonnox; charged on lands at Crugwallows and Lanjet, in parish of St. Stephen in Brannel. *Nil. April 13, 1926.

LIGHTWOOD BRICK AND TILE CO., LTD., Stoke-on-Trent. Registered September 24, £8,500 debentures; general charge.

MEAKIN (J. AND G.), LTD., Hanley, earthenware manufacturers. Satisfaction registered September 17, £17,200, part of amount registered May 3, 1909.

PEMBERTONS (GATESHEAD), LTD., paper manufacturers. Registered September 13, £5,000 debentures; general charge. *£15,000. July 24, 1925.

REDHILL TILE CO., LTD.—Registered September 13, £200 and further advances not ex. therewith £800 charge, to T. Cotching, Horsham, solicitor; charged on properties at Honeycrock Lane, Salfords, Horley. *£4,500. July 17, 1925.

Satisfactions

BOWATER'S PAPER MILLS, LTD., Northfleet. Satisfaction registered September 22, £50,000, registered July 3, 1926.

REDHILL TILE CO., LTD. Satisfaction registered September 27, £800 (not ex.), registered September 13, 1925.

ST. CUTHBERT'S PAPER WORKS, LTD. (late PIRIE WYATT AND CO., LTD.), Wells (Som.). Satisfaction registered September 11, all moneys, etc., registered March 23, 1926.

London Gazette, &c.

Company Winding Up Voluntarily

PENCOED AND DINAS POWIS BRICK AND TILE CO., LTD.—At an extraordinary general meeting of the members of the above-named company, duly convened, and held on August 13, 1926, at "Sunrise," Plymouth Road, Penarth, the following resolution was duly passed; and at a subsequent extraordinary general meeting of the members of the said company, also duly convened, and held on September 3, 1926, at "Sunrise," Plymouth Road, Penarth, such resolution was duly confirmed:—"That the company be wound up voluntarily, and that Mr. Geoffrey Knill Singer, of Hermon Chambers, Tonypandy, be and is hereby appointed liquidator of the company."

China Clay Imports for September, 1926

A RETURN showing the registered imports of China Clay (including China Stone) into Great Britain and Northern Ireland from the several countries of consignment during the month of September, 1926, indicates that the imports were nil.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests.
Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., Bouverie House, 154, Fleet Street, E.C.4. All communications relating to Advertisements, Subscriptions, etc., should be sent to the Manager, "The China Clay Trade Review," at this address. Telegrams—"Allangas, Fleet, London." Telephone—City 0244 (10 lines).

China Clay Trade Movements

FOR the first month this year we have to record a falling-off of the total tonnage of business done over the year, compared with the corresponding period last year. Month by month this year we have been able to record in our return of deliveries a substantial increase above the corresponding monthly totals of last year, until now the total volume has dropped below it.

As will be seen by a reference to the monthly statistics we publish elsewhere in this issue, the difference in favour of last year in all classes is 22,145 tons, 20,000 of this being due to the drop in the October figures from the September figures. Last year's figures were helped considerably by the fact that October last year was a bumper month, the remarkable quantity of 89,682 tons having been shipped, whereas this year October records only 63,491 tons, much below the monthly average. China Clay accounts for nearly 10,000 tons of the difference on the ten months China stone for nearly 6,000, and ball clay for nearly 7,000.

China Stone and Ball Clay Decreases

It will be noted that the ratio of decrease to total volume is very considerable in the cases of China stone and ball clay, the decrease in China Clay deliveries by comparison being slight. This may be accounted for by the fact that, value for value, China Clay is now the cheapest raw material of the three on the market. It is a significant feature of the business of China Clay firms who sell China stone and ball clay as well, that, when the prices of China Clay are high the demand for China stone and ball clay is greater, and, *vice versa*, when China Clay is cheap the demand for China stone and ball clay is less. This see-saw factor applies mainly in the case of the use of these raw materials in ceramic manufacture in which all three are used in varying proportions.

Why the Drop

The drop in total volume of trade for the ten months is not surprising having regard to the increased difficulties with which the China Clay industry is having to contend. The spurt in demand up to September was a reflection of the concern felt by buyers at the prospect of the formation of a new Association to control output in the interests of producers. It was a shrewd move on the part of buyers to attempt to circumvent the all-round rises in prices that were to have operated as from January next. They acquired large stocks which they have not yet been able to assimilate, hence the cancelling or postponement of orders for a more favourable season.

Coal Strike Effects

Another factor that is influencing them to act thus is the immediate effect of the coal strike on prices which they hope will ease immediately there is a general resumption of work by the coal miners. Buyers who are banking on this possibility may suffer disillusionment before long. It must be realised that China Clay producers have not passed on anything like the increased cost of production, involved by the high price of coal, to their customers, and if there is any easement in the coal price and sea freight

position they will expect to recoup themselves before thinking of reducing the present prices of their products. If we read the position aright and understand the attitude of producers on the subject, we cannot see any material change in existing prices of China Clay in a downward direction. On the other hand, there may be a swift upward movement, for, despite the collapse of the new association project, it must be borne in mind that the Big Five in the trade command the situation, owing to their exceptionally favourable position in regard to best clays which hold the key to the price question.

Successful Retention of Markets

The big drop in orders revealed by the October figures is not alarming when viewed in the light of the above observations. It is a matter for gratification that trade has been maintained up to last year's volume so long as it has, seeing how other industries have suffered. And it is not because the industry requires less coal than some other industries that have suffered more, because the drying of China Clay calls for the use of enormous quantities of coal. Between 12 and 15 tons of clay dried to a ton of coal is a good average. Seeing that the average monthly drying output is round about 70,000 tons, a simple calculation will show that the coal requirements of the industry are considerable. And this apart from the substantial quantity required to keep pumping and winding engines going.

The coal strike has been a source of great anxiety to the China Clay industry, on both the production and financial sides. That it has been successful in retaining the overseas markets throughout the strike, is at once a tribute to its business acumen and resourcefulness, and a testimony to the preference consumers have for English China Clays.

Clays in New South Wales

Some interesting information in regard to the origin, distribution, and industrial uses of clays in New South Wales has appeared in a recent number of the *Industrial Australian and Mining Standard*. The value of clays produced in the state in 1925 was £310,384. Summing up, the author (Mr. H. Raggatt, of the Department of Mines, New South Wales) states that "On reviewing the State's resources of clay, we find that for most purposes the known deposits of clay are more than sufficient for the current demand. There appears, however, to be a very real need for the location of a deposit of true kaolin. 'Kaolin' is a much maligned word. Any white clay is not a kaolin. The true kaolins of commerce are associated with felspathic rocks, such as granite, and it is in these areas that search should be made, particularly in the New England and Bathurst districts. The resources of high-grade filler clays are ample to supply domestic needs, and fireclays are also abundant. The clay industry appears to be well established in all its branches, and as the State's clay resources are more fully exploited and understood, the industry cannot but grow as the population increases, causing an augmented demand for products in which clay is an important ingredient."

Clays as Portland Cement Ingredients

Value of Alumina and Silica Contents

HAVING regard to the fact that certain grades of clays produced in Cornwall and Devon are used in the manufacture of Portland cement for specific purposes, the following details of experiments with limestone, chalk and clay, from the French *Review Matériaux de Construction* of June this year should add to the knowledge of clay producers as to the value of brands produced by them in cement manufacture. The chemical composition of artificial Portland cement usually varies, as we know, within the following limits:—

	Per cent.
Loss in fire	0.50 to 3
Silica (SiO_2)	30 to 20
Alumina (Al_2O_3)	3 to 10
Iron oxide (Fe_2O_3)	1.50 to 3.50
Lime (CaO)	59 to 60
Magnesia (MgO)	traces to 4
Sulphuric anhydride (SO_3)	0.25 to 3
Hydraulic modulus	1.80 to 2.10

The best results are obtained with cements of which the composition is about as follows:—

	Per cent.
Loss in fire	0.50
Silica (SiO_2)	22.91
Alumina (Al_2O_3)	6.75
Iron oxide (Fe_2O_3)	3.00
Lime (CaO)	64.34
Magnesia (MgO)	2
Sulphuric anhydride (SO_3)	0.50
Hydraulic modulus	1.97
Silic modulus	2.35

Though it is easy to increase the percentage in lime of a mixture, and consequently the hydraulic modulus, this cannot be done with the silicic and ferro-aluminous moduli, which have a great effect not only on the quality of the cement, but also on manufacture, especially burning. With a same percentage of lime experiments have long demonstrated that: (1) Cements rich in silica set very slowly but regularly, and that their resistance, rather weak at first, increases considerably on keeping the test pieces; (2) Cements rich in alumina and poor in silica set more rapidly with more initial resistance, but only show slight increase; (3) Cements containing a high percentage of iron have a great resistance, especially to sea water.

Experiments with Limestone and Clay

This study was made in connection with a new cement works, and the samples received consisted of limestone and clay. The limestone was very regular in aspect, of uniform white colour, and somewhat unctuous to touch, which showed that it was rather clayey; on the other hand, the hardness gave promise of easy grinding. The following was an analysis of this stone:—

	Per cent.
Loss in fire	41.74
Silica (SiO_2)	4.01
Alumina (Al_2O_3)	1.70
Iron oxide (Fe_2O_3)	0.50
Lime (CaO)	51.78
Magnesia (MgO)	0.09
Sulphuric anhydride (SO_3)	0.06

This analysis demonstrated that the limestone was of a superior quality for artificial Portland cement, as it did not contain any substance prejudicial to manufacture, magnesia and sulphates being present only in traces, and the silica soluble. Moreover, this limestone was clayey and not sandy, with an amply sufficient percentage of calcium carbonate. Finally, it contained a little alumina and iron, which could but have a favourable effect on the composition of the mixture.

The clay used was a yellow sandy earth, without plasticity, mixed with limestone debris. Analysis gave:—

	Per cent.
Loss in fire	28.86
Soluble silica (SiO_2)	6.40
Insoluble silica (sand)	28.84
Alumina (Al_2O_3)	4.05
Iron oxide (Fe_2O_3)	3.21
Lime (CaO)	31.64
Magnesia (MgO)	0.96
Sulphuric anhydride (SO_3)	0.11
Calcium carbonate	56.50

Value of the Clay

Thus, being too sandy, this clay could not be employed alone for a good artificial Portland cement; in fact, most of the silica was insoluble, viz., quartz, and a paste made with the clay would burn defectively. Instead of perfect formation of tricalcic silicate in burning, there would be production of bicalcic silicate, giving clinkers falling into dust when taken from the kiln; moreover, the amount of alumina in this clay was relatively small, but as it contained a high percentage of calcium carbonate the proportion of clay to utilise in this mixture was rather great. As the limestone contained alumina, there would be 3.9 to 4 per cent. in the cement, which is yet rather little. Thus, according to these analyses this clay would have to be mixed with a clay containing soluble silica and a higher percentage of alumina. Tests made with the cement produced by burning these materials mixed in the calculated proportions were as follows. It must be first noted that, as anticipated, the clinkers fell to dust when taken from the kiln. When ground down to a degree of fineness giving 1 per cent. residue on a sieve with 900 meshes per sq. cm. and 15 per cent. on one of 4,900 meshes, a cement was made having a normal initial setting, adding 3 per cent. plaster after one hour 25 minutes, whereas the end of setting was not finished in 18 hours.

These clinkers gave a cement with normal initial setting after addition of 3 per cent. plaster, in one hour, but the end of setting was not obtained in 18 hours. The stability tests also gave negative results, complete disaggregation in boiling water, steam, and even the oven, at a temperature of 120° C. Kept in water the test pieces were not disaggregated, but resistance was very poor—e.g., pure 9 kg. and mortar 5 kg., after 7 days. Considering these results, the resistance tests were not continued after 28 days, but a corrective clay was immediately looked for, for mixing with the first. The following was an analysis of this second clay, mixed with the first in the proportion of 3 to 1:—

Clay No. 2	Per cent.
Loss in fire	9.38
Soluble silica (SiO_2)	61.22
Insoluble silica (sand)	traces
Alumina (Al_2O_3)	22.56
Iron Oxide (Fe_2O_3)	5.58
Lime (CaO)	2.02
Magnesia (MgO)	0.32
Sulphuric anhydride (SO_3)	traces

The mixture of one part of Clay No. 1 with three of clay No. 2 gave an average composition of clay as follows:—

	Per cent.
Loss in fire	14.25
Total silica (SiO_2)	53.72
Alumina (Al_2O_3)	17.93
Iron oxide (Fe_2O_3)	4.98
Lime (CaO)	9.42
Magnesia (MgO)	0.48
Sulphuric anhydride (SO_3)	traces

It was also to be noted that the quantity of insoluble silica was reduced to 6.16 per cent. by this mixture, which yet seemed high but which, nevertheless, would give a good cement, the more so as alumina and iron were amply sufficient; in fact, the tests with a cement made by burning these materials gave the following results, the fineness of grinding being with 15 per cent. residue on a sieve of 4,900 meshes and 1 per cent. with 900 meshes per sq. cm.: Initial setting, 2 hrs. 10 mins.; final setting, 6 hrs. 45 mins. As regards stability, the test piece resisted boiling water for six hours, and the Chatelier apparatus recorded an expansion of 7 mm. The resistance tests gave:—

	Kg.
Tensile, with pure cement, after 3 days in water ..	36
" " " " 7 " " " ..	56
" " " " 28 " " " ..	72
Mortar 1 to 3, 7 days in water ..	19
" " 28 " " " ..	24
Density	3.12

Owing to these studies and tests, the first clay, which came from limestone quarry waste, was not rejected but mixed with

clay No. 2, and a cement of very good quality was thus obtained.

Chalk and Clay Experiment

This examination was made in a cement works where many difficulties were met with in manufacture. In the first place, the clay was very plastic and difficult to grind—i.e., it did not blend well with the chalk. The clay formed adhesive round lumps in the mill, which clogged the steel balls and impaired efficiency. To remove the paste from the mill a large quantity of water had to be added, as much as 42 per cent., and in spite of this the mixture of chalk and clay did not blend. Composition of the raw materials utilised was as follows:—

	Per cent.
Chalk, soft and regular—	
Loss in fire	42.12
Silica (SiO_2)	3.10
Alumina (Al_2O_3)	1.46
Iron oxide (Fe_2O_3)	0.38
Lime (CaO)	52.48
Magnesia (MgO)	0.15
Sulphuric anhydride (SO_3)	0.15
Clay, bluish grey, plastic and with very regular composition—	
Silica (SiO_2)	51.32
Alumina (Al_2O_3)	20.91
Iron oxide (Fe_2O_3)	4.05
Lime (CaO)	3.20
Magnesia (MgO)	traces
Sulphuric anhydride (SO_3)	70.84
Loss in fire	—

The burnt cement was of very good quality, except for setting, which required a very high percentage of gypsum (6 per cent. even) to be normal. There was also trouble in burning caused by excessive adhesiveness, and often also formation of round lumps which had to be taken out or broken to prevent damage to the crown of bricks placed at the exit of the kilns. Tests made with the cement gave the following results:—

	Kg.
Pure, 3 days	39.50
" 7 "	58.70
" 28 "	70.10
Mortar, 1 to 3, 7 days	23.00
" " 28 "	26.00

To remedy the inconveniences of setting and manufacture caused by this clay, it was mixed, in the proportion of 2 to 1, with a sandy clay of the following composition:—

	Per cent.
Loss in fire	8.74
Silica (SiO_2)	69.36
Alumina (Al_2O_3)	11.30
Iron Oxide (Fe_2O_3)	3.62
Lime (CaO)	5.34
Magnesia (MgO)	0.55
Sulphuric anhydride (SO_3)	0.80

This gave a clay with an average composition as follows:—

	Per cent.
Loss in fire	8.14
Silica (SiO_2)	57.33
Alumina (Al_2O_3)	21.70
Iron oxide (Fe_2O_3)	6.46
Lime (CaO)	5.87
Magnesia (MgO)	0.16
Sulphuric anhydride (SO_3)	0.02

The cement produced by burning this mixture of clay with chalk made it possible to avoid all trouble in manufacture. It had properties as shown under:—

	Hr. m.
Setting, initial	2 13
" end	7 40
Stability, good.	
Resistance—	Kg.
Pure, 3 days	30.50
" 7 "	52
" 28 "	73
Mortar, 1 to 3, 7 days	22
" " 28 "	26

It was concluded that the inconveniences in manufacture due to excessively plastic, that is, excessively aluminous clay, were illustrated in this work. Moreover, it was shown that employment of such a clay gave a cement with high initial resistance, but of slow progression.

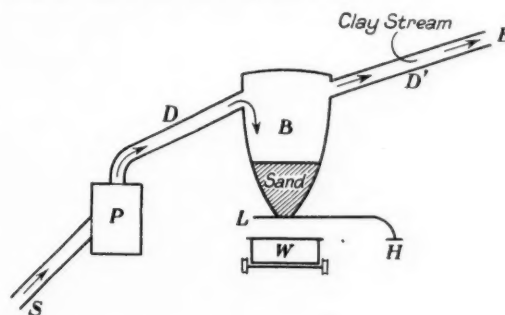
Modern China Clay Machinery

Growing Use of Mechanical Methods

ONE of the most noticeable changes which is taking place in the China Clay industry is the substitution of human labour by mechanical work. Production and purification are being mechanised in every possible phase of work. The old standard method of washing was to allow a stream of water to fall over the clay face. Workmen were employed breaking the clay into the stream. This method of washing is still widely practised, but hydraulising hoses are now fairly general and are often used side by side with the older method to increase production. The pressure is that obtained from the natural head of water or that obtained by artificial means, such as a pressure pump. If sufficient pressure can be obtained at the nozzle the jet of water from the hose cuts the clay face, and there is therefore no need for men to break the clay. Until comparatively recently Cornish pumps were the only pumping arrangements on clay works. This method of pumping is slowly but surely giving way to centrifugal pumping. The Cornish pumps from the very nature of things can deal with the clay stream only after all the coarse sand has been removed from it. A certain amount of fine sand remains in suspension in the clay stream until it reaches the refining drags, but the total weight of the fine sand in suspension is small compared with the weight of sand the stream brings down with it from the face. Where Cornish pumps are used, the coarse sand is collected in the bottom of the pit, shovelled into wagons, and drawn up over the dump.

Patent Sand Pits

One of the first successful attempts to dispense with human labour in connection with the removal of sand from the bottom of pits was the introduction of patent sand pits which are so constructed that the sand wagons can be run on rails right underneath the pit. When a patent pit is full of sand the bottom is opened by suitable means, the wagon filled with sand, and hauled away over the dump. A still more recent and more successful method of dealing with China Clay sand is to use centrifugal sand pumps. The pumps can deliver water, clay, coarse sand, and fragments of stone up to the size of a lemon, direct from the bottom of the pit to a convenient level. The sand can either be allowed to accumulate and form a beach around the point where it is discharged by the pump, or it can be trammed away. The centrifugal pump thus does away with the necessity of having three or four men continuously employed in the bottom of the pit shovelling sand from sand pits or sand boxes to wagons. There is also a saving in haulage expenses, and this applies even if the sand has to be hauled from the point of delivery over the dump, as the hauling distance is lessened. Incidentally the elimination of sand pits in the bottom of a mine enables a wider area of clay to be worked, and also does away with the necessity of diverting the clay stream from one sand box to the other.



An ingenious improvement on the usual method of trapping or collecting the sand from the delivery pipe of a centrifugal pump has been adopted in one works. In the diagram shown above S represents the suction pipe of the sand pump P, and D, D' the delivery pipe. The delivery pipe is tapped at a convenient distance between the pump and the end E, and an iron box 'B' with an opening at the bottom inserted. E is the end of the delivery pipe, where the clay stream with its sand and stone is usually discharged. By means of the arrangement B drawn above, most of the heavy coarse sand and all

the lumps of stone travelling up the pipe D D' fall into the box B so that only the clay stream and fine sand issue at E. L represents a sliding shutter worked by a handle H, which is operated to open and close the bottom of the box B. A pump capable of dealing with 15 tons of solid matter per hour worked at full speed would fill a one-ton box in about four minutes. On opening the shutter the sand in the box falls into the wagon W and is wheeled away. By trapping the coarse sand and stone half way up the pipe a greater head for the clay stream is obtainable with the same power, as the pumps used in the China Clay industry can force slurry up to a greater height than slurry and sand combined. The usual labour in shovelling sand into wagons is dispensed with and costs reduced.

A modern innovation in China Clay works is the mechanical excavator to remove overburden and sand. It appears that some of the older generation of China Clay producers dumped the sand in the most convenient spot, and it has been found in many works that the sand dumps rest on beds of good clay. The removal of the sand and overburden, especially if the sand is piled high and the overburden deep, is a slow process even with the best workmen in the world. To speed up matters at least one firm has installed an excavator and steam shovel. This means a considerable saving in human labour, and if the experiment is successful, excavators will possibly become as popular with China Clay producers as centrifugal pumps. In spite of all the mechanical devices introduced with the object of economising and dispensing with human labour, there does not at present appear to be any prospect that less men will be required for China Clay production. Production is increasing year by year, and as fast as men are displaced by machinery in one direction, they are re-engaged on essential work, not yet mechanised, in another direction. What is certain, however, is that owing to the introduction of modern machinery, and the adoption of modern methods for producing and refining China Clay, the increase in the rate of production exceeds the increase in the number of men engaged in the industry.

E. J. L.

Prosperity of Fowey

At the luncheon given by the new Mayor of Fowey (Mr. R. Varco), the Rev. F. Danby, proposing "Prosperity to the Borough of Fowey," said they were all interested in the prosperity of Fowey. From a material point of view it seemed to him that there were two distinct interests, widely apart in character, which contributed to the prosperity of Fowey. There was the natural charm of Fowey, river, hill and sea, which was without a rival, and it was not surprising, therefore, that Fowey had become a popular health and pleasure resort as well as a desirable residential district. The other interest was to do with business and the commerce which brought so many large vessels to their harbour. It had grown very extensively—far beyond all the expectations and the dreams of 50 years ago—in connection with the development of the China Clay industry. They could not look upon Fowey as prosperous until it embraced all sections of the community. They felt sure that the interests of Fowey were safe in the hands of the council, and that the council would not forget Fowey as a residential centre as well as a commercial centre.

Responding, Alderman J. G. Lewarne (the retiring Labour Mayor) claimed that the council had done something for the prosperity of Fowey, more particularly in the last twelve months. He went over the achievements of the council, referring to the work of the members of the council on the Harbour Board, and said that dredging was being undertaken on a large scale and superseded the old method, whereby the harbour became filled almost as soon as it was cleared. They were looking forward to any emergencies that might arise. They could congratulate themselves upon the health of the borough, for they were free from infectious diseases. He referred to the gift of Mr. J. Julian on the esplanade and hoped that access to the esplanade would be given, as it was more convenient than the Squire's Field for the old people. He hoped they would be able to say next year that the rates had not gone up. They had a hard struggle but they had managed up to the present without raising the rates. Trade would boom again when the coal miners went back, but China Clay had not suffered as it might have done, and Fowey itself had not suffered as other ports had done.

Clay Association Analogies

WHEN one reads what has been done by State regulation in the matter of production in the rubber industry and sees what America is proposing to do in the regulation of cotton output, it is all the more to be regretted that those associated with the China Clay industry could not come to a common understanding as to voluntary regulations in the output of China Clay, writes a West Country Editor. The restrictions in regard to rubber, which prevented the world's market being flooded with the commodity with disastrous results to the producers, may be said to have saved this great British industry. America, though it cried out so loudly in protest against these restrictions because she is the chief buyers of rubber, now proposes to restrict cotton output somewhat upon similar lines, because there has been such an abnormal harvest. China Clay may not be a commodity of such importance as either rubber or cotton, but it is difficult for the ordinary man to understand why those concerned should go on producing it in excess of market requirements, only unreasonably to depress the price at which the consumer has to buy. Where cost of production cannot be covered by selling price in the markets of the world, it is not incompatible for the permanent interest of both producer and consumer that the former shall be saved from bankruptcy and the latter from any danger of shortage that would ensue if the situation were left to work itself out by what are termed natural means. Possibly our Cornish China Clay producers will rub along somehow until a trade revival comes, and all their output is readily absorbed, but I still think a mistake has been made by those who were not prepared to come into the proposed Association.

Fowey Honours Old Townsman

PRIOR to the choosing of Fowey's new mayor (Councillor R. Varco), a large number of people assembled in the Town Hall to witness the conferring of a great honour—the second of its kind only in the history of the borough—upon an old and respected former townsman, the presentation of the freedom of the borough to Mr. Simeon Rowe. In conferring the honour the mayor read the address as follows: "Borough of Fowey.—At the Council of the Mayor, Aldermen and Burgesses of the Borough of Fowey, held on the fifth day of October, 1926, in the presence of his Worship the Mayor (Alderman J. G. Lewarne), Aldermen Shadwell, Vincent, Knight, and Councillors Allchin, Beale, Whetter, Mitchell, G. Varco, Curtis, Spratt, W. H. A. Tucker, W. Tucker and Hambrook, it was proposed by the Mayor, seconded by Alderman Shadwell, and resolved: That Simeon Rowe, in 1922-23 Mayor of Fowey, and previously in succession Councillor and Alderman, be admitted an honorary freeman of the Borough in recognition of his private and public worth, his life-long loyalty to his native town and in particular his vigilant charity towards all sick persons and young children, of a man in brief, who through many years proud of Fowey's past, yet strove to leave his birthplace even better than he found it."

Death of Mr. Andrew Peters

THE death has occurred at Hove of Mr. Andrew Peters, elder son of the late Mr. Woodman Peters and Mrs. Peters. Mr. Peters, though the son of one of the founders of the China Clay firm of Parkyn and Peters, did not, like his brother Mr. Lewis Peters, enter the business but entered the Civil Service. For several years before his retirement a few years ago he occupied a responsible position in the Educational Department in London. He was a frequent visitor to St. Austell, where his mother and sister (Mrs. Michell) still live. The death of Mr. Peters has come as a surprise to his friends at St. Austell, who were not aware that his illness was serious.

China Clay Imports for October, 1926

A RETURN showing the registered imports of China Clay, including China Stone, into Great Britain and Northern Ireland from the several countries of consignment during the month of October, 1926, indicates that 6 tons, value £60, were imported from Germany, and 10 tons, value £95, were imported from Czecho-Slovakia: the total imports being 16 tons, value £155.

China Clay Notes and News

New Pottery Company

Plymouth Pottery Co., Ltd., Thistle Park Road, Plymouth: To take over the business carried on at Plymouth as Gee Brothers and Co., together with the properties and assets appertaining thereto; and to carry on the business of clay-workers, potters, etc. Nominal capital, £1,000 in £1 shares. Directors: H. J. Gee, 6, Marine Fields, Cosside, Plymouth; H. J. Gee, Jr., same address; A. Yeo, "Stangroy," Hadley Park Villas, Plymouth; H. E. Turner, 5, Meadpool Terrace, Plymouth. Qualification of directors, £10. Remuneration of directors as voted by the company.

English China Clays' Office Fire

A remarkable piece of "hustling" work was carried out on the roof of the offices of English China Clays, Ltd., at At. Austell, following the recent destructive fire. The office organisation has been continued uninterruptedly despite the handicap of building operations. "Business as usual," has been the office slogan. The captain of the fire brigade, Mr. T. J. Smith, whose prompt measures saved the body of the building, has addressed the following letter of thanks to the other voluntary workers: "On behalf of the members of the St. Austell Fire Brigade I thank the police and all who assisted the Brigade on that occasion, but more especially those who at some risk to themselves helped the Brigade in the first five minutes to get the lines of hose to the roof, thus preventing the total destruction of the building and contents."

Size of Paper Filler Particles

Methods for the determination of the size of filler particles are given by R. Lorenz, *Papierfabr.*, 24, 91-92 (February 7, 1926). The article is the concluding one of a series on methods for the evaluation of the size of paper filler particles. The graphical interpretation of settling curves is discussed with reference to Stokes' Law. Optical methods for measuring the size of filler particles are subject to errors, and can only be regarded as semi-quantitative. Screening methods are recommended only for coarser material that is usually found in paper fillers. Sedimentation methods fill the requirements, since they permit the calculation of all particles within the limits of 0.1 mm. and 0.1 micron, according to Stokes' formula. The Gessner procedure of photographing and graphically interpreting the settling curves is the most accurate method.

Barytes and Fluorspar Output

A statement of the Mines Department shows the output of barytes, witherite, and fluorspar for the quarter ended March 31 to be as under:—

	Output of mineral. Tons	Average percentage of metal in the mineral.	Net selling value of the mineral at mine, quarry, or works.	
			Total Amount. £	Average per ton. £ s. d.
Barytes and witherite:				
(a) Not ground	5,982	—	8,059	1 6 11
(b) Ground—				
(1) Bleached	556	—	2,351	4 4 7
(2) Unbleached	3,586	—	8,385	2 6 9
Fluorspar	12,264	84 (Calcium fluoride)	12,116	0 19 9

China Clay and Writing Paper Durability

As regards the durability of writing paper, tests carried out at the Swedish Government Testing Institute, Stockholm, show that: (1) The tensile strength is increased and elongation decreased on increasing the speed at which the Schopper tester is run; (2) no difference in folding resistance is observed when running the machine at 80 and 110 double folds a minute, and an increase of about 5 per cent. on running it at 140 double folds a minute; (3) better agreement is obtained in the determination of tensile strength than in the determination of folding resistance; (4) Under the action of light and heat, the folding resistance of paper made from bleached sulphite decreases much more rapidly than that of unbleached or bleached cotton or linen rag paper; (5) Increase in the

copper number of the fibrous material probably reduces the durability of the paper; (6) Rosin sizing caused a decrease in the folding resistance and an increase in the acidity of the paper, as compared with unsized paper; (7) Deterioration in durability due to rosin sizing is probably not sufficient to render rosin sizing unsuitable for paper intended for keeping indefinitely, provided excess of aluminium sulphate is avoided; (8) Aluminium acetate does not seem to present any advantage over aluminium sulphate, from the standpoint of durability of the paper; (9) Sizing with animal glue increases the folding resistance as compared with unsized paper, but the increase is lost comparatively on exposure to light and heat, and on storing at ordinary temperature; (10) The degree of acidity of tub-sizing within the limits generally accepted in practice has little or no effect upon the durability of the paper; (11) Loading with a mixture of China Clay, gypsum, chalk, asbestos, and Swedish talcum has a beneficial rather than detrimental effect on the durability of the paper.

Coal Strike and China Clay

Speaking at a political meeting at St. Austell, Mr. G. Pilcher, M.P. for the division, describing the coal position as "this quarrel, this struggle, this fight, this war," between those who owned the capital and made working in the mines possible, and those who worked in the mines, remarked that it was jeopardising all the happiness and wealth in these islands. It was typical of these people who thought they could make them all happier much quicker than they could be made happier. There were 600,000 men out of work in addition to the million miners, and that had not brought more happiness to anybody one single day nearer than it was 18 months ago. It had postponed the happiness of everybody in it. Every woman's interest was at stake in the coal problem, which made coal and wood much dearer.

Mr. Pilcher came to matters of graver and more important local interest when he said he had heard in the district that the number of men stood off in the China Clay trade owing to the coal difficulty was 200, and if things did not improve there might be a thousand out of work within a month or six weeks. That was not making St. Austell or the country generally any happier or more prosperous. They stood pre-eminently for an attempt to get together the working man and the owner of capital—and the idea of the owners as a group of rogues was wrong. Instead they had a picture of a class that was out for greed and lust and rapine, hate was being generated, and they saw the condition of the State getting steadily worse instead of better. They could not, by any conjuring trick, change the whole conduct of people's lives and make things different and better than they were.

Fluorspar and Cryolite

As fluorspar and alumina occur in China Clay, which is sometimes used for purposes for which these mineral constituents are desirable, the following observations of Mr. Hubert W. Davies, of the United States Bureau of Mines, on the occurrence of fluorspar and cryolite in the States, and their uses, are interesting. Fluorspar, or fluorite, is a non-metallic crystalline material that usually occurs in glassy transparent cubes or cleavable masses; less commonly it is granular or fibrous in structure, and occasionally is banded. Fluorspar has a specific gravity of 3.2, is brittle, has a hardness of 4, and can easily be scratched with a knife. Chemically it consists of calcium and fluorine in the proportion of 51.1 to 48.9. In colour fluorspar ranges, according to purity, from a clear colourless or slightly bluish, glasslike substance through various brilliant hues, of which purple and green are most common; much of it is white and opaque.

Notwithstanding the record production of steel in 1925, the shipment of fluorspar to steel plants was 12 per cent. less than in 1924. There was also a decrease of 12 per cent. in shipments of fluorspar to foundries. Of the higher grades of fluorspar the shipments to manufacturers of glass and hydrofluoric acid were, respectively, 11 and 41 per cent. more than in 1924, but the shipments for use in enamel and sanitary ware were 7 per cent. smaller. The total shipments of fluorspar from U.S. mines in 1925 amounted to 113,669 short tons, valued at \$2,052,342, a decrease of 9 per cent. in quantity and

16 per cent. in total value as compared with 1924. The general average value per ton f.o.b. mines or shipping ports for all grades in 1925 was \$18.06, a decrease of \$1.55 dollars from the average in 1924. Cryolite occurs in commercial quantities, and is mined only in Greenland, at Ivigtut. Formerly two-thirds of the production was sold to the Pennsylvania Salt Co., and the other third went to Copenhagen, but at present these relative proportions are reversed. Of the cryolite shipped to the United States the greater part is now used as a flux in the metallurgy of aluminium and for making opaque glass. In aluminium metallurgy in this country the mineral is being supplanted by an artificial cryolite.

£570 Fete Profit

The fete organised at St. Austell for the St. Austell District Hospital realised the magnificent profit of £570, £500 of which has been handed over to the treasurer, Mr. H. Stocker, who has expressed the thanks of the hospital committee for such a record result.

A Cornish Landowner's Estate

A note-writer in *Truth*, writing on the recent flotation of the Earl of Strathmore's estates as a company, says, "On a much larger scale is the Molesworth St. Aubyn Estates Co., which has also been formed recently, with a capital of £350,000. Sir Hugh Molesworth St. Aubyn is the life governing director. The Molesworths added St. Aubyn to their estates when a younger son, whose descendants eventually came into the title, married the heiress of that family. The Molesworth baronetcy was the first created by William III, and was conferred upon a second son, with remainder to his elder brother who succeeded him. The family have been seated at Pencarrow, in Cornwall, since the time of Queen Elizabeth."

Fowey Town Clerk's House Robbed

Following an alleged burglary committed at the house of Mr. Henry S. Graham, solicitor, of Fowey, and Clerk to the Fowey Borough Council, Sydney Philip Johnson and Fred Morgan, of no fixed abode, were last month charged at Tywardreath before Messrs. R. Santo and R. Vincent with breaking into Gorse Cottage, the residence of Mr. H. S. Graham, and stealing a gun-metal watch, value £1, a pair of gold cufflinks, value £1, two boxes of cigarettes value 3s., the property of Mr. H. S. Graham; a gold watch and seal value £5, the property of Miss C. M. Kelly, housekeeper at Gorse Cottage, and about 10s. in cash from a missionary box. At the subsequent Assizes at Bodmin, Johnson, an old offender, was sentenced to a term of imprisonment, but Morgan was discharged.

China Clay Men's Police Encounter

There was a sequel to an early morning encounter with a police constable in the China Clay district, when at St. Austell Police Court James Crews, clay labourer, Treviscoe, and William Sanders, clay works engine driver, of Treviscoe, were charged with assaulting P.C. Trays while engaged in the execution of his duty at Trethosa on Sunday, November 7, at 2 o'clock in the morning. Accused, who pleaded guilty, before Messrs. J. W. Higman and Arthur Rowett, were fined £5 each. Frank Roberts, of St. Stephens Coombe, a night-watchman employed on the drainage scheme at Trethosa, said he saw the two accused hanging around at about one o'clock in the morning and he told them to go away. They refused, so he sent for P.C. Trays. The constable arrived and witness saw the two accused assault him. P.C. Trays said he saw the two accused in a gateway. They would not give any account of their actions. On proceeding to search them, Crews struck him a severe blow on the cheek-bone and ran away. Sanders then caught hold of him and prevented him going after the other man and also struck him. Witness then searched accused and told him to go home. Sanders was a married man. He had to go a mile after accused, who was a single man, and followed him to his home at Treviscoe.

Clayworkers' Band Success

The success of Stenalees band in carrying off the premier prize in one of the sections at the recent Crystal Palace National Band Festival, was celebrated at Stenalees early this month by a number of functions which included a complimentary luncheon to which supporters of the band were invited. Mr. J. W. Higman presided, and the chief guest

was the president, Sir Edward Nicholl, the Cardiff ex-shipping magnate, formerly M.P. for the Division. Mr. Sydney Grose submitted "The Band and Officials," and said that as an old Stenalees boy he remembered when the band used to practise in the Single Rose engine house over forty years ago.

Mr. E. H. Whale, chairman of the Stenalees Band Committee, responding, said one of the causes of their success was the wonderful support they got throughout the district and further afield, as was evidenced by the splendid list of vice-presidents and patrons they were able to put on their programme for their annual band festival. Another reason was the splendid team work of the band, individual bandmen losing sight of self and working for the success of the band. The men's employers, too, had been most helpful. The band had to fulfil many engagements during the season, and the employers on all occasions had done all they possibly could to assist the band and give them opportunities to go away for engagements.

In handing over the shield, Sir Edward Nicholl, as president, congratulated the band on its wonderful success. Very few people succeeded in the efforts they made the first time. But Stenalees had, and had also won on two occasions a trophy he had presented. He referred to the Cornish propensity for music. The chairman of the committee having referred to a magnificent cheque Sir Edward had sent to the band on their success, Sir Edward promised that if Stenalees won at the Palace next year he would give them £50.

Clay Co. Directors Entertain St. Dennis Band

To celebrate the success of the St. Dennis Prize Silver Band as champions of the West of England at the Bandsmen's Festival at Bugle this year, a successful social function was recently held in the new hall in St. Dennis Institute. This took the form of a complimentary supper given by the chairman and directors of H. D. Pochin and Co., Ltd. The Hon. H. D. McLaren, the head of the firm, presided, and other officials of the firm present were Mr. H. Stanley Pochin and Mr. David T. Taylor. Among the visitors were Mr. J. W. Higman, J.P., of St. Austell; Mr. T. Medland Stocker, of English China Clays, Ltd.; Mr. J. Hoyle, Manchester China Co., Ltd., and Mr. R. Hooper, manager of H. D. Pochin and Co., Ltd. Mr. Hooper is the chairman of the band, and Mr. McLaren is the president.

Giving the toast "St. Dennis Silver Prize Band," the chairman said the achievements of the band had been so remarkable that he could not trust merely to memory to recite them. They had won the Prince of Wales's Cup five times in the last seven years and in doing so this year they had become the champions of the West of England. They had also won the ladies' open trophy, the One and All trophy, carrying with it the championship of Cornwall; the Brenton Cup, and the Lambe cup. The band's success must be due to the Cornish musical temperament, because Cornishmen had always been noted musicians ever since the time they were pirates. It was due to hard work, and also, he believed, to something better than hard work and that was team work. It was a fine thing for the men to work together and for the district to have a team like the band in it. He was proud that more than half the band came from the men with whom his firm were associated at Gothers. He had always known that Gothers was very celebrated for its musical talent, for which he suspected that credit was due to Mr. R. Hooper, the firm's manager. He aimed to wash the clay at Gothers to the strains of music with the old Cornish engine beating time. Other mines such as Wheal Remfrey, Gunheath and South Caudledown had also many talented musicians. He welcomed it because he thought that a man who threw his energy into music or into anything, threw his energy into his work and was willing to co-operate with the whole team, which was necessary to run a business.

Mr. J. Best, a player in the band, referred to the assistance given to the band all along by H. D. Pochin and Co., Ltd. At a time when there was distress and unemployment, and things were looking black for the band, Mr. McLaren and his co-directors stepped forward and by their active interest made it possible for them to gain the position they now occupied. The toast of "Our Guests" was proposed by Mr. H. Stanley Pochin and responded to by Captain Whitford Hawkey, and Mr. John W. Higman, J.P. Mr. T. Medland Stocker gave the health of Messrs. H. D. Pochin and Co., coupling with it the name of Mr. H. D. McLaren.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—October, 1926

Arrived.	Name.	Sailed.	Destination.
October 1, s.s.	<i>Joffre Rose</i>	October 12,	Bruges
October 1, s.s.	<i>Fairfield</i>	October 5,	Grimsby
October 1, s.s.	<i>Coaster</i>	October 6,	Northfleet
October 3, M.V.	<i>Neptunus</i>	October 6,	Odense
October 3, s.s.	<i>Jolly Angela</i>	October 12,	Newlyn
October 3, s.s.	<i>Blush Rose</i>	October 7,	Preston
October 3, s.s.	<i>Gronant Rose</i>	October 3,	Hook of Holland
October 3, s.s.	<i>Blanche</i>	October 7,	Brussels
October 3, s.s.	<i>Primrose</i>	October 7,	Weston Point
October 5,	<i>Aegena II</i>	October 12,	Gravelines
October 5, s.s.	<i>Ribbledale</i>	October 7,	Jersey
October 5, s.s.	<i>Ruth</i>	October 6,	Antwerp
October 5, s.s.	<i>Mistley</i>	October 13,	Ridham
October 5, s.s.	<i>Avanville</i>	October 9,	Weston Point
October 7, M.V.	<i>Vesta</i>	October 13,	Sodertelje
October 7, s.s.	<i>Mersey</i>	October 11,	Manchester
October 8, s.s.	<i>Ferdene</i>	October 15,	Plymouth
October 8, M.V.	<i>Hela Naval</i>	October 12,	Harburg
October 8, s.s.	<i>Hillglade</i>	October 12,	Boston
October 9,	<i>Najaden</i>	October 11,	Charlestown
October 11, s.s.	<i>Kempton</i>	October 19,	Amsterdam
October 11, s.s.	<i>Abercraig</i>	October 10,	Ridham
October 11, M.V.	<i>Theodora</i>	October 12,	Mevagissey
October 12, M.V.	<i>Mayblossom</i>	October 12,	Looe
October 12, s.s.	<i>Southwell</i>	October 13,	Ardrossan
October 12, s.s.	<i>Florentino</i>	October 13,	Genoa
October 13, s.s.	<i>Dorset Coast</i>	October 15,	Liverpool
October 14, M.V.	<i>Ingeborg</i>	October 15,	Karlskrona
October 14, s.s.	<i>Frida</i>	October 19,	Oscarshamn
October 14, s.s.	<i>Munkfors</i>	October 15,	Gothenborg
October 15, s.s.	<i>Haig Rose</i>	October 10,	Bo'ness
October 15, s.s.	<i>Golfer</i>	October 18,	Tayport
October 16, s.s.	<i>Guelder Rose</i>	October 18,	Rotterdam
October 16, s.s.	<i>Blush Rose</i>	October 20,	Runcorn
October 17, s.s.	<i>Zaansdroom</i>	October 20,	Amsterdam
October 17, s.s.	<i>Mersey</i>	October 21,	Ridham
October 17, M.V.	<i>Claus Henrich</i>	October 21,	Harburg
October 17, s.s.	<i>Beatty Rose</i>	October 18,	Rotterdam
October 17, M.V.	<i>Donald and Doris</i>	October 26,	Rochester
October 18, s.s.	<i>Pansy</i>	October 30,	Fleetwood
October 18, s.s.	<i>Ferulea</i>	October 23,	Philadelphia
October 18, M.V.	<i>Kurt</i>	October 21,	Harburg
October 18, s.s.	<i>Primrose</i>	October 21,	Preston
October 18, s.s.	<i>Brier Rose</i>	October 23,	Fleetwood
October 19, s.s.	<i>Clydeburn</i>	October 25,	Rouen
October 19, s.s.	<i>Odda</i>	October 23,	Norrkoping
October 20, s.s.	<i>Calluna</i>	October 30,	Brussels
October 20, s.v.	<i>Esperance</i>	October 30,	Gravelines
October 20, M.V.	<i>Lynher</i>	October 22,	Plymouth
October 21, s.s.	<i>Wild Rose</i>	October 22,	Rouen
October 22, s.s.	<i>Sambre</i>	October 27,	Passages
October 22, s.s.	<i>Sturdee Rose</i>	October 22,	Antwerp
October 22, s.v.	<i>Lady Daphne</i>	*	London
October 23, s.s.	<i>Joffre Rose</i>	October 23,	Ghent
October 23, s.s.	<i>Oak</i>	October 24,	Par
October 23, s.v.	<i>W. E. Gladstone</i>	October 26,	Plymouth
October 24, M.V.	<i>Annie</i>	October 25,	Par
October 24, s.s.	<i>Sunngentco</i>	October 29,	Portland, Me.
October 24, s.s.	<i>Suremico</i>	November 3,	Philadelphia
October 24, s.s.	<i>Wyke Regis</i>	November 3,	Antwerp
October 24, M.V.	<i>Alzina</i>	October 26,	Pentewan
October 25, s.v.	<i>Rossing</i>	October 26,	Charlestown
October 25, M.V.	<i>Capable</i>	October 26,	Bideford
October 25, M.V.	<i>Shortest Day</i>	October 26,	Plymouth
October 25, s.s.	<i>Rose</i>	October 30,	Antwerp
October 25, s.s.	<i>Dorset Coast</i>	October 29,	Liverpool
October 26, M.V.	<i>Mayblossom</i>	October 30,	Plymouth
October 26, s.s.	<i>Hagfors</i>	October 30,	Drammen
October 26, s.s.	<i>Emerald</i>	October 30,	Bruges
October 26, M.V.	<i>Fridius</i>	October 30,	Rouen
October 26, s.s.	<i>Mount Charles</i>	October 30,	Gravesend
October 27, s.s.	<i>Fairfield</i>	October 30,	Ridham
October 27, M.V.	<i>Karnten</i>	October 30,	Terneuzen
October 28, s.s.	<i>Cisneros</i>	October 29,	Genoa
October 28, s.s.	<i>Suscolanco</i>	*	Portland, Me.
October 28, s.v.	<i>Dencise M.</i>	October 31,	Par
October 29, s.s.	<i>Foynes</i>	November 3,	Antwerp
October 29, s.s.	<i>Brier Rose</i>	November 2,	Garston
October 29, s.s.	<i>Claretta</i>	November 3,	Antwerp
October 29, s.s.	<i>Groningen</i>	October 31,	Par

October 30, s.s.	<i>Blush Rose</i>	November 4,	Preston
October 30, s.s.	<i>Primrose</i>	*	Runcorn
October 30, M.V.	<i>Mary B. Mitchell</i>	*	London
October 31, s.s.	<i>Stanwell</i>	*	Antwerp
October 31, s.s.	<i>Foch Rose</i>	*	Dublin
October 31, s.s.	<i>Surbiton</i>	*	Antwerp
October 31, s.s.	<i>Gertrude May</i>	*	Chiswick
October 31, s.v.	<i>W. E. Gladstone</i>	*	Truro
October 31, s.s.	<i>Martha</i>	*	Sarpsborg
October 31, s.s.	<i>Suwarinco</i>	*	Boston, Mass.
* In Port.			

Charlestown Shipping—October, 1926

Date.	Vessel.	From.
October 1,	<i>Elsa</i>	Plymouth
October 2,	<i>Mary Sinclair</i>	Hayle
October 7,	<i>Vera</i>	Trangsund
October 7, s.s.	<i>Porthcarrack</i>	Cardiff
October 8,	<i>Cornwall</i>	Stromfors
October 9,	<i>Najaden</i>	Plymouth
October 17,	<i>Fortuna</i>	Viborg
October 17,	<i>Mary Barrow</i>	Falmouth
October 22, s.s.	<i>Porthleven</i>	Hayle
October 23, s.s.	<i>Oak</i>	Newport
October 25,	<i>Rossing</i>	Castletown
October 25,	<i>Katie</i>	Barry
October 30,	<i>Harvest King</i>	Penryn
October 30, s.s.	<i>Maralie</i>	Torquay

Sailings

Date.	Vessel.	Destination.
October 4, M.V.	<i>Dietrich Hasseldieck</i>	Bremen
October 5,	<i>Elsa</i>	Granton
October 6,	<i>Mary Sinclair</i>	Rochester
October 8, s.s.	<i>Porthcarrack</i>	Ridham
October 11,	<i>Najaden</i>	Leith
October 21,	<i>Vera</i>	Helsingborg
October 21,	<i>Cornwall</i>	Aberdeen
October 22,	<i>Mary Barrow</i>	Rochester
October 23, s.s.	<i>Porthleven</i>	Antwerp
October 25,	<i>Oak</i>	Gravesend

Par Harbour Shipping—October, 1926

Sailings

Date.	Vessel.	Destination.
October 2, M.V.	<i>Haukur</i>	Brahestad
October 4, M.V.	<i>Hope</i>	Plymouth
October 5, s.s.	<i>Balmyle</i>	Honfleur
October 6, s.v.	<i>Waterwitch</i>	Newcastle
October 7, s.v.	<i>Shortest Day</i>	Plymouth
October 7, s.s.	<i>Porthleven</i>	Terneuzen
October 9, s.s.	<i>Condor</i>	Antwerp
October 11, s.s.	<i>Southwell</i>	Fowey
October 11, s.s.	<i>Porthleven</i>	Antwerp
October 20, s.v.	<i>Carmenta</i>	Antwerp
October 20, s.s.	<i>Trader</i>	Gravelines
October 22, s.v.	<i>Alfred Rooker</i>	London
October 22, s.s.	<i>Pegrix</i>	Rochester
October 22, s.s.	<i>Stanwell</i>	Terneuzen
October 23, s.s.	<i>Vilvoorde Maritime</i>	Antwerp
October 23, s.s.	<i>Condor</i>	London
October 25, M.V.	<i>Hope</i>	Plymouth
October 26, s.s.	<i>Magrix</i>	London
October 27, s.s.	<i>Southwick</i>	Terneuzen
October 29, s.s.	<i>Wearside</i>	Antwerp

Arrivals

Date.	Vessel.	From.
October 2, s.v.	<i>Waterwitch</i>	Falmouth
October 3, s.v.	<i>Shortest Day</i>	Truro
October 3, s.s.	<i>Balmyle</i>	Terneuzen
October 4, s.s.	<i>Condor</i>	Terneuzen
October 4, s.s.	<i>Porthleven</i>	Newport
October 7, M.V.	<i>Ingeborg</i>	Petes
October 7, s.s.	<i>Southwell</i>	Antwerp
October 8, s.s.	<i>Porthleven</i>	Antwerp
October 8, s.v.	<i>Alfred Rooker</i>	Forthoustock
October 12, s.v.	<i>Carmenta</i>	Falmouth
October 16, s.s.	<i>Trader</i>	Plymouth
October 19, s.v.	<i>Henrietta</i>	London

October 19, S.S. Condor	Antwerp
October 20, S.S. Pegrix	Kingsbridge
October 20, S.S. Stanwell	Hayle
October 20, S.S. Vitorde Maritime	Penryn
October 20, S.V. Emma Ernest	London
October 21, M.V. Venturer	Truro
October 22, M.V. Hope	Falmouth
October 23, S.S. Magrix	Truro
October 23, S.V. S. F. Pearce	Plymouth
October 25, S.S. Southwick	Antwerp
October 26, S.V. Clytia	Falmouth
October 26, M.V. Annie	Truro
October 26, S.S. Wearside	Terneuzen
October 29, S.S. Norrix	Plymouth
October 30, S.V. Guiding Star	Mevagissey
October 31, S.V. Denise M.	Fowey
October 31, S.S. Groningen	Terneuzen

Par Harbour Tide Table, December, 1926

(Greenwich Mean Time Throughout.)

Day of Week.	Month.	Morning.	Afternoon.	Height.
Wednesday	1	2.21	2.47	10.11
Thursday	2	3.11	3.33	11.7
Friday	3	3.54	4.14	12.1
Saturday	4	4.34	4.53	12.6
Sunday	5	5.12	5.31	12.9
Monday	6	5.50	6.10	12.10
Tuesday	7	6.30	6.49	12.10
Wednesday	8	7.8	7.28	12.7
Thursday	9	7.48	8.11	12.2
Friday	10	8.34	8.59	11.8
Saturday	11	9.25	9.53	11.1
Sunday	12	10.23	10.56	10.8
Monday	13	11.31	—	10.7
Tuesday	14	0.9	0.46	10.10
Wednesday	15	1.22	1.56	11.6
Thursday	16	2.27	2.57	12.1
Friday	17	3.25	3.52	12.6
Saturday	18	4.18	4.43	12.10
Sunday	19	5.8	5.31	12.11
Monday	20	5.58	6.14	12.10
Tuesday	21	6.35	6.55	12.7
Wednesday	22	7.5	7.20	12.2
Thursday	23	7.51	8.9	11.8
Friday	24	8.27	8.46	11.2
Saturday	25	9.5	9.25	10.7
Sunday	26	9.40	10.8	10.1
Monday	27	10.32	10.59	9.9
Tuesday	28	11.28	11.59	9.7
Wednesday	29	—	0.31	9.9
Thursday	30	1.4	1.38	10.2
Friday	31	2.10	2.40	10.9

E. CLEMENS, Harbour Master.

China Clay Exports for October, 1926

A RETURN showing the exports of China Clay, including Cornish or China Stone, the produce or manufacture of the United Kingdom from the United Kingdom to the countries of destination registered during the month ended October 31, 1926:

COUNTRY OF DESTINATION.	CHINA CLAY	
	QUANTITY.	VALUE.
	Tons.	£
Finland	1,426	1,479
Estonia	582	650
Latvia	543	847
Sweden	2,636	6,703
Denmark	539	1,409
Germany	1,815	3,926
Netherlands	2,464	6,667
Java	103	395
Belgium	3,061	4,837
France	640	1,146
Spain	1,075	2,484
Italy	1,627	4,027
China	5	27
Japan	54	340
United States of America	23,001	48,082
Cuba	11	87
Colombia	1	11
Brazil	20	76
Nigeria	—	1
Cape of Good Hope	—	5
Bombay via Other Ports	1,191	4,882
Bengal	159	555
Australia	72	423
Canada	544	1,446
Total	41,569	90,511

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

JONES (GEORGE) AND SONS, LTD., Stoke-on-Trent, china manufacturers.—Registered September 30, £5,000 debentures (secured by deed dated October 25, 1899), present issue £1,400; general charge. *£25,075. April 13, 1926.

LOWER LANSALSON AND CAUDLEDOWN CHINA CLAY CO., LTD. (late LOWER LANSALSON CHINA CLAY CO., LTD.), Stoke-on-Trent.—Registered October 2, £18,000 debentures, part of £65,000; general charge. *£44,500. April 13, 1926.

REDHILL TILE CO., LTD.—Registered October 16, £200 and further advances not ex. therewith £600 charge, to T. Cutching, Hersham, solicitor; charged on properties in Honeycroft-lane, Salfords, Horley. *£4,500. July 17, 1925.

ST. CUTHBERT'S PAPER WORKS, LTD. (late PIRIE WYATT AND CO., LTD.), Wells (Somerset).—Registered September 29, trust deed dated September 10, 1926, securing £75,000 and bonus of 2½ per cent.; charged on properties at Wells (Somerset), etc., 25,000 fully paid ordinary shares of £1 each in Inveresk Paper Co., Ltd.; also general charge. *£55,000. April 1, 1926.

Satisfactions

ANCHOR CHINA CLAY CO., LTD. (late ANCHOR CHINA CLAY SYNDICATE, LTD.), London, E.C.—Satisfaction registered October 21, £2,900, registered December 12 and 13, 1918, and January 25, 1919.

BODELVA CHINA CLAY CO., LTD., St. Austell.—Satisfactions registered October 4, £500, part of amount registered July 12, 1916; and £100 registered May 26, 1922.

ENGLISH CHINA CLAYS, LTD., St. Austell.—Satisfaction registered October 7, £16,000, registered June 25, 1920.

LOWER LANSALSON AND CAUDLEDOWN CHINA CLAY CO., LTD. (late LOWER LANSALSON CHINA CLAY CO., LTD.), Stoke-on-Trent.—Satisfaction registered October 2, £10,000, part of amounts registered December 13, 1921, and February 27, 1924.

REDHILL TILE CO., LTD.—Satisfactions registered October 8, £800 (not ex.), registered June 14, 1926; also registered October 20, £800 (not ex.), registered August 9, 1926.

London Gazette, &c.

Winding Up Petition

REIGATE BRICK AND TILE CO., LTD.—A creditors' petition for winding up has been presented and is to be heard at Scarbrook Road, Croydon, Surrey, at 10.30 a.m., on November 24.

October Deliveries Down

Drop on Month and Year

THERE was a drop of over 20,000 tons in the total trade done by the China Clay producing firms in October compared with September, over 18,000 being in respect of China Clay. The following are the details, together with comparisons with 1925:

Port.	China Clay.		China Stone.		Ball Clay.		Total.	
	1926.	1925.	1926.	1925.	1926.	1925.	1926.	1925.
Fowey	47,526	60,909	3,025	4,234	70	5,680	50,621	70,823
Par	4,436	4,591	42	1,133	—	—	4,478	5,726
Charlestown	2,940	7,026	—	—	—	—	2,940	7,026
Plymouth	1,013	442	—	36	—	—	1,013	478
Falmouth	130	534	—	—	—	—	130	534
Penzance	—	550	—	—	—	—	—	550
By rail	4,309	4,485	—	—	—	—	4,309	4,485
October	60,354	78,597	3,067	5,405	70	5,680	63,491	80,682
9 months	665,344	656,530	30,363	33,938	17,441	18,634	713,148	709,102
10 months	725,698	735,127	33,430	30,343	17,511	24,314	776,639	798,784

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests.
Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., Bouverie House, 154, Fleet Street, E.C.4. All communications relating to Advertisements, Subscriptions, etc., should be sent to the Manager, "The China Clay Trade Review," at this address. Telegrams—"Allangas, Fleet, London." Telephone—City 0244 (10 lines).

China Clay Trade Outlook

THE statistics showing total volume of trade for November, which we publish elsewhere in this issue, reveal the gratifying fact that there has been no continuance of the heavy falling-off of business in October. The drop of 20,000 tons on a single month was somewhat disappointing to the industry, though it was easily explicable by the fact that the coal stoppage had reached its zenith as a depressing factor on trade. The November figures show a total turnover of 66,936 tons against 63,491 tons in October, an increase on the month of 3,445 tons. China Clay showed a falling-off of 189 tons, the net increase on the month in the aggregate trade being shared by Ball Clay with an increase of 1,754 tons on the month, and China Stone with an increase of 742 tons. There was an increase of about 3,000 tons in the shipments from Fowey, but a falling-off of nearly 2,000 tons from Par. From Plymouth there was a falling-off of over 400 tons. These decreases were to a large extent made up by the shipment of 1,190 tons from Penzance, against nil in October. Compared with the turnover in the corresponding month last year, the deliveries were down by about 18,000 tons.

Eleven Months' Trade

The total deliveries in all departments for the eleven months ended November 30 now total 843,575 tons against 883,006 tons for the corresponding eleven months last year, a difference in favour of last year of 39,431 tons. This disparity is not so serious as it may appear on the surface, having regard to the effect of the coal strike upon the industries using China Clay. Apart from the direct effect of the coal supply difficulties, as distinct from questions of price and quality on the industry directly, it has suffered considerably from the falling-off of demand on the part of big clay-consuming industries, which have also been seriously affected as a result of the coal dispute. Potteries, paper mills, cotton mills, and chemical works, generally big consumers of China Clay, have been compelled seriously to curtail production, and in some cases have had to close down altogether, through the shortage and high price of coal. With more plentiful supplies of good quality coals, all these industries are beginning to come back into the market for supplies of China Clay. There are not wanting signs that the influence of this revival of interest in trade development will before long have an effect upon demand for China Clay, and the other raw materials produced by China Clay firms.

Time Too Short to Recover this Year

While it does not appear that there is sufficient time this year for this influence to get to work to overtake the trade difference between this year and last, there are considerations which go to show that the effects of the coal strike on China Clay merchants are merely temporary. It must be borne in mind that when we compare this year's trade

with last year's, 1925 was an exceptional year for the China Clay industry and was the record post-war year, and that it came, so far as China Clay and China Stone are concerned, within 3,000 tons of the "boom" pre-war year of 1912. Moreover, it was the first complete year to benefit, from the point of view of volume, from the break in prices in the autumn of 1924 following the disbandment of the China Clay Association. In 1925 the industry made a jump of 58,315 tons on the volume of 1924, and so far this year, despite the depressing conditions under which trade has been carried on, has lost only 39,431 tons of the 1925 increase.

It is a tribute to the efficiency of the organisation and the capacity to meet industrial reverses of individual China Clay firms, that during a period of exceptional industrial difficulty, they have for the most part been able to keep their overseas markets intact, though this has not been done without some sacrifice on their part. The falling-off has been due mainly to the falling-off in demand in the home markets. To a comparatively small extent can it be said that any falling-off in volume has been due to any incapacity on the part of China Clay producing firms to deliver the goods.

1927 Hopes

In 1927 the industry is looking forward to a bumper year, and in its realisation coal will play a very important part, especially if the price can be brought below the pre-stoppage figure, which it is anticipated will be the case early in the summer. Next to labour, coal represents by far the biggest item in production costs, and if the industry's fuel supply is secured on better terms than before the coal stoppage, it will be placed in all the stronger a position, not only to maintain its old overseas markets, but to open up new markets.

Unemployment Position

At the time of writing, the effects of high costs and the necessity for working the China Clay pits on the narrowest possible margin, has unfortunately necessitated the standing off of a large number of men, so much so that it has been necessary to revive the voluntary relief fund which was established following the post-war slump in the industry. It is hoped that the increase in the unemployment figures is only temporary, and that early in the New Year the staffs of most of the China Clay firms will be restored, to prepare for the heavy demands which are expected to be made on the output from the works early in the spring. Apart from the large number of men who are likely to be required on the repletion of China Clay stocks, it is expected that many will be required consequent upon the revival of development work which has been suspended during the coal stoppage. It is expected that the influence of cheap coal will be felt to a very considerable extent in the advancement of the China Clay industry during the coming year.

Sedlec (Zettlitz) Kaolin

Its History, Occurrence and Production

ALTHOUGH Sedlec (Zettlitz) kaolin is well known everywhere, the same cannot be said of the origin of the natural rock or the operations necessary to produce the washed kaolin. Articles can be found on the composition, and especially on the properties of this kaolin, articles which are of great interest to specialists; but as they are scattered about in books and periodicals they are not easily accessible. In a recent number of the *Revue des Matériaux de Construction* an account of the subject is given.

According to Dr. Kallauner, engineer (professor at the Czecho-Slovakian Polytechnic of Brno), who made a special study of the subject, Sedlec kaolin was discovered at the beginning of the nineteenth century by the owners of land near Sedlec (Czecho-Slovakia). The result of this discovery was the foundation of the rich porcelain works in North-East Bohemia, which owes all its greatness to this kaolin, and also to the vicinity of coal mines. German industry early recognised the quality of Sedlec kaolin, and has made use of it extensively. The growing demand for this clay caused an increase in production, and washeries were constructed by Lorenz, R. Gotl, D. Zebisch, and J. Pfeiffer. In 1912 their successors founded the well-known company "Société d'Exploitation du Kaolin de Sedlec," who now own most of the kaolin deposits and washeries in the district. The deposit occupies an area of six kilometres to the north of the village of Sedlec, near Karlary Vary (Karlsbad). There is an enormous quantity of kaolin, as shown by the pit shafts, which are 50 metres deep, and have not yet passed through the bed of clay.

Structure and Origin of Kaolin Deposits

Not far away from the edge of the bed, at a depth of 20 to 25 metres, the granite bearing kaolin (Rozsival) was found. The bed of high-grade kaolin is covered by a bed of inferior quality containing stones, sand, grey, black, red, and blue micas, and a coal seam. Over all there are sedimentary beds. The primitive kaolin is the product of decomposition of the felspar in the granite. Hitherto, however, geologists have not agreed as regards the nature of this decomposition. Most of them hold the opinion of Stremme, who maintains that kaolin is formed by the action of water, carbonic acid, and perhaps micro-organisms. This idea is corroborated by the decrease of kaolin with depth, and also by the presence of organic matter. Finally a light grey aggregate is found consisting chiefly of sand quartz, kaolinite, mica, non-decomposed felspar, tourmaline, rutile, pyrites, and other rarer minerals. After washing, 25 to 45 per cent. (average 30 per cent.) kaolin is produced, in which there is 25 per cent. porcelain kaolin (Ia) and 5 per cent. paper making kaolin (IIa). The deposits are worked with mining shafts and galleries. There are nine shafts—viz., Primlovice, Lorenz (workings 2, 3) Apollo (4), Bohemia (5), Austria (6), Reinwart (9), and Excelsior (7). The trend of the gallery roadways is very complicated, as they must be propped to resist great pressures, especially lateral ones. Beams 50 centimetres thick are often broken. The water is removed with electric pumps.

Method of Working

Trucks loaded with kaolin run to the shafts, which are 60 to 70 metres deep. Electricity is utilized for power; but there are steam engines and boilers in case of breakdown. The kaolin is conveyed to the storage place from which it is removed by railway, motor lorries, and carts to the washeries. To facilitate transport the Apollo shaft is connected with the Excelsior by an overhead line, and a second similar line is utilised for transport of coal.

The Sedlec company has ten washeries—viz., Primlovice (workings 10), Zebisch-Pfeiffer (11, at Sedlec), Erlenmühle (12), Lorenz (14) at Dalvice, Widitz-Moulin (13), Katzenholz (15) at Otovice, Sadov at Sadov (16), V. Gotl (19) at Stara Role, and R. Gotl (1 and 2, workings 20 and 21), at Rybare. The most important of all is Sadov. The Sadov washery comprises the washers, carpentry, mechanical, and electro-technical workshops, etc., as well as a chemical laboratory and the management department of several washeries.

The kaolin is carried away from all the works to the washeries, where it is loaded into little trucks running on a narrow gauge

line, and raised by a hoist to the first floor of the washery, where it is emptied out on to the working place. Here there is a heavy grating with openings 15 centimetres in diameter, on which the kaolin is thrown. The large pieces are broken with a hammer to enable them to pass through, after which the kaolin is run through mills and taken to the Excelsior washery by an endless band conveyor acting as an automatic feeder. This machine is continually supplied with water from a large pond, 87 hectares in area, near Lichtenstadt, passing through two other ponds to be cleansed, about 500 metres from the washery. The water runs through a main into a reservoir on the third floor of the washery, where it is filtered through a metal strainer and then a cloth filter, after which it mixes with the raw kaolin. The mixture thus formed runs from the receptacle on overflows, freed from the coarse sand. The washing tank is continually cleared of sand. As there are always small portions of sand and mica left in the kaolin, it is allowed to deposit, and is then poured off into an automatic machine, from which it is run to a concrete sand separator (a concrete channel in which the liquid kaolin flows to deposit sand). The sand from the washer and automatic machine is collected in trucks, conveyed to the second floor of the washery, and then hauled by a little locomotive to a special yard.

Treatment of Liquid

The liquid kaolin consists chiefly of kaolinite, some fine quartzose sand and mica, a little felspar, etc. To separate these foreign substances the kaolin is first run through a sieve into three concrete sand separators successively. A wooden beam floats in the second separator to stop all the floating matter. Sand and mica are precipitated to the bottom of the separators and pumped into special tanks. From the third sand separator the liquid kaolin runs through a sieve and wooden gutter into a set of concrete washers, where part of the kaolinite is separated with very fine sand and mica (Kaolin IIa). Flowing through the gutter the kaolin then passes through another sieve, while being continually fed with lime water, into a concrete settling tank, where the slime and very pure kaolin separate. Freed from this slime, the water is removed by pumps, whilst the slime left on the bottom of the tank is pumped into press filters, where it is made into kaolin cakes (Kaolin Ia).

The Kaolin IIa left in the gutters is conveyed to a concrete tank surrounded by a mechanical mixer, whence it is pumped into special press filters to obtain cakes of Kaolin IIa, which are broken into three pieces and put into shelved trucks, which carry them to the dryers (system Podhajsky, Prague, Hostivar) to be dried with hot air coming through a set of steam heaters. There are two boilers with a heating surface of 250 sq. metres, and two others in reserve, fired with coal from the Catherine mine. The kaolin cakes when dried only contain 4 to 6 per cent. of water, and are put into a store room on a thick wooden floor where they are packed in bags of 50 kilos and carried away in trucks to the railway to be sent off to consumers. The empty bags are returned to the works and carefully washed to prevent the fresh kaolin from being contaminated. All the machines and hoists are driven by electricity from the electric works of the Dutchoy-Podmoklys-Nove-Seldo railway. The voltage of 3,000 volts is transformed for the machinery to 220 volts, and to 120 volts for lighting. To keep iron out of the kaolin all the channels, screws, and sieves are made of copper or copper alloy, free from iron. The washing is continually supervised, especially as regards the density of the liquid kaolin, which is measured every ten minutes. Then the quality of the prepared kaolin is examined in the laboratory from the point of view of fineness, percentage of clay, plasticity, colour after burning, etc. The daily production at Sadov is $4\frac{1}{2}$ trucks of Ia kaolin and $\frac{3}{4}$ truck of IIa kaolin, with 76 workmen. To drive the machines 150 kilowatt-h. are required. All the other installations work in the same way. There is the greatest cleanliness everywhere, and the production is controlled in the laboratory. Recently special new machines have been tried, simpler than press filters, to concentrate the kaolin.

The annual production amounts to 20,000 trucks of crude kaolin, and the washeries produce 4,000 trucks of Ia washed

kaolin and 500 of IIa. The plant consists of 10 washers (mixers), 100 press filters, 13 drying rooms, and 10 other dryers. There are 70 employees and 800 workmen. The markets for kaolin are in relation with the porcelain industry, and represent 1,000 trucks of Ia and 500 of IIa kaolin per annum. This total is utilised to the extent of 41 per cent. of Ia and 18 per cent. IIa, in the country itself, whilst 51 per cent. and 55 per cent. respectively are exported to Germany, and 2.1 per cent. of Ia kaolin to Italy. Then follow, in order, exports

to Poland, Switzerland, Sweden, Belgium, Austria, America, and Denmark. The remainder goes to Holland, France, Hungary, Great Britain, and Lithuania. The director-general, V. Gotl, has organised work in such a way that products of uniform quality are obtained, which is a very important point, especially in the case of porcelain. The secret of the good results consists in careful attention to the plant, regular washing of the kaolin, absolute cleanliness, perfect control, and long experience.

Utilisation of Clays and Shales in Manitoba

The Brick and Tile Industry

THERE are two sources of materials in Manitoba for the brick and hollow tile industry—the surface clays and the shales and clays of earlier age, mostly cretaceous, interbedded with other rock formations in the province. The surface clays have been much more extensively used than the older shales and clays, and are the exclusive raw materials at the present time. These clays are operated at Winnipeg (Alsip Brick and Tile Co.), Whitemouth (McCutcheon), Portage la Prairie (Snyder), Edrans (National Clay Products), and Gilbert Plains (Snyder). Surface clay is excavated as well at Firdale, to mix with the Winnipeg surface clay at the Alsip plant for rough face brick. This represents the operations in the province at the present time (apart from two sand lime brick plants in Winnipeg), and is a small list in comparison with that of the time of building expansion, 1908-1913. None of the brickworks established to operate on the older shales are now active, and the La Riviere and Carman plants have been dismantled.

Surface Clays

The surface clays, on which operations are now based, vary somewhat in the different parts of the province. As a rule they are lake or river deposited; where river deposited they frequently contain lenses of sand which serve to mix with the otherwise fairly stiff clay. Where high in lime, as at Winnipeg, St. Boniface, Whitemouth and Portage la Prairie, the resulting brick is white or pale buff in colour, the lime taking up the iron to form a colourless lime iron silicate. On the edge of the sand hills of the old Assiniboine delta, on the other hand, at Lavenham, Sidney, Firdale and Edrans, where the lime content in proportion to the iron is lower, the clay burns to varying shades of red to chocolate brown. The surface clay is also of varying degrees of plasticity, the plasticity increasing towards the Red River valley, where the underclays, underneath the 3 feet of clay now used for brick, are so highly plastic that they are not capable of manufacture without special treatment. With the highly plastic clays there may occur checking on air drying through excessive shrinkage; and care is taken to prevent too rapid drying. The surface clays of the Winnipeg area have a high fusion temperature; and the bricks have been found to stand prolonged contact with the surface soils and clays without any evidence of disintegration.

Growing and Varying Demand

During the years of building expansion prior to 1913, brick of any quality was in demand, and the main output was common brick, manufactured by the soft mud process, and burnt in scove kilns. Nearly all the face brick of superior quality was imported at high prices. With the revival of building, and the slowly growing demand for brick, it is increasingly necessary to supply, if possible, not only the common brick which the plants operating in the province can supply, but also the much higher priced face brick, which has been imported from Fort William, St. Louis, Minneapolis, Moose Jaw, Medicine Hat and elsewhere. While a considerable part of this imported material has been smooth faced dry press brick, there has been a growing demand for wirecut tapestry brick which is capable of strikingly decorative effect.

The colours which have been most sought after in face brick have been dark red to chocolate brown or brownish green. It is this market that efforts are now being made to supply, to some extent successfully, within the province. At the Alsip plant, by admixture of a loamy clay from Firdale (upper 10 ft.) with the surface clay (upper 3 ft.) from their own yards, a tapestry brick (stiff mud) of shades of red, brown, and green is being produced which is used as a face brick in five of the

apartment blocks now being built in Winnipeg. This is a notable advance in meeting the competition of outside bricks. At Edrans, where a dry press brick of fairly deep colour has been produced, a stiff mud process plant is being installed to produce a tapestry brick. Some very effective flashed brick has been got here; and with careful screening of pebbles this plant should also supply part of the face brick demand which has previously been met from outside the province. Burning has been done in three downdraft rectangular kilns and two scove kilns.

Common and Face Brick

It is recognised by the manufacturers that the face brick industry does not in itself have a sufficient local market. The main volume of the brick business (90 per cent. or more) is in common brick. The face brick business in this province will probably tend to become an adjunct to the manufacture of common brick, with the use if necessary of mixtures of clays, or clays and shales, for face brick or hollow tile. As already stated, the common brick from the Red River valley burns light buff to grey, and is for common brick unusually refractory. Various grades of red are obtained from clays on the Manitoba escarpment and on the sand hills; but some of these clays are lacking in plasticity and mixing with the more plastic clays improves the qualities of both types.

There is also a field for experimentation in the under clays (40 ft. or more in thickness) in the Red River valley, which cannot be handled, owing to abnormal plasticity, in the raw, but if preheated to 300° C. are easily worked and burn to a pleasing salmon red colour. At Edrans a dry-press brick is made from the surface clay (upper 5 ft.); and fairly deep red uniform colours, as well as brown flashed faces, are obtained. At Leary a bright red dry-press brick was made from the carbonaceous Niobrara shales, burnt in a downdraft kiln; the plant has not been in operation for the past eight years.

Provincial Development

Hollow brick, hollow tile, and drainpipe are produced at the stiff mud plants in the province. Sewer piping was manufactured for a short time at Carman by admixture of Niobrara and Pierre shales; and the brick plant in North Winnipeg (Winnipeg Clay Products, Ltd.) was built to handle vitrified brick as well as face brick or hollow tiles from a mixture of similar shales. No clay products of higher grade, such as fire brick or pottery ware, have been produced; and for this purpose no clays are available of the grade of some of the clays of southern Saskatchewan. The most refractory clay which is available in quantity is a clay horizon associated with the Dakota Sandstone in the Swan River valley, eight miles down stream from the town of Swan River. This may be of value for furnace brick if smelting operations are initiated in the copper areas of Northern Manitoba.

To summarise, the present demand for common brick is being met by five brickworks, producing white, buff, or pale red bricks from surface clays by the soft mud process. The use of reinforced concrete and stone in the larger business buildings, and of stucco finish in bungalow and cottage residences, has for the time relegated brick to apartment blocks, schools, and similar buildings; the demand for brick has consequently not kept pace with building expansion. Considerable progress has been made in meeting the demand for tapestry brick by the mixing of clays in the province; and further progress is possible, particularly by preheating the under clays of the Red River valley, which are too plastic in the natural state, and of which a depth of 40 ft. of uniform material is available. For

sewer pipe and vitrified brick, mixtures of cretaceous shales must be used: and a fairly refractory brick may be obtained from the Dakota shale horizon in the Swan River valley. Refractory clays for firebrick and pottery ware, such as occur in southern Saskatchewan, have not been found in Manitoba, with the exception of what appears to be a limited occurrence of kaolin on Little Deer Island, Lake Winnipeg. Ample raw material is available for the common brick market: and the indications are that all but the most exclusive demands in face brick will be supplied from sources within the province as well.

G.W.R. St. Austell Developments

Probable Benefit to China Clay Trade

THE Great Western Railway have issued a notice to the effect that they intend to apply to the next session of Parliament for powers to acquire by agreement or compulsion certain lands in the Parish of St. Austell Urban and Urban District of St. Austell lying on and adjoining the northern side of the company's Cornwall Railway, and between points respectively 14 chains and 32 chains east of the bridge carrying the public road over that railway at the eastern end of St. Austell Station.

The land referred to lies to the left of the railway, going in the direction of Mount Charles, below the footpath where it crosses the railway. The land to be acquired represents several acres of agricultural land, and stretches to Higher Watering Lane on the east and to Polkyth Road on the north. It is bounded on the south by the railway embankment and on the west by Mr. J. S. Lovering's grounds. The company's decision to abandon their original scheme of expansion in the direction of North Hill adjacent to the St. Austell Station is partly because of the price demanded for the land there and partly because of difficulty of access to it in view of the opposition of the Urban Council to the closing of the level crossing. Apart from securing the consent of the Urban Council to the closure of the level crossing, the G.W.R. would have had difficulty in carrying out the project, while, to continue to maintain it in connection with the North Hill scheme would have been fraught with considerable difficulty to themselves and inconvenience to the public. Whatever was the deciding factor, the result to the public and the G.W.R. will be more satisfactory, and probably less expensive to the latter.

Effect on China Clay Traffic

It is the intention of the G.W.R. to provide extensive sidings and accommodation for goods traffic on the land referred to, the need for which has been emphasised for several years. The scheme, when carried out, will make St. Austell Station much more convenient for the expeditious dispatch of China Clay.

The G.W.R. main scheme will involve the expenditure of many thousands of pounds, and will provide employment for a large number of men during its construction. The Bill under which they are seeking the necessary Parliamentary powers has yet to be passed, so that it will probably be some considerable time before a start can be made. It is to be hoped that operations may not be unduly delayed, because the restrictions on traffic at St. Austell and consequently on the expansion of trade are such as to make the provision of more accommodation imperative. Commercially, St. Austell is a centre possessing great potentialities which will quickly respond to the enterprise of the G.W.R. in providing the necessary facilities for the smooth and expeditious working of trade.

Incidentally it is gratifying to note that the company are at last responding to the insistent demands which have been made for a long time by traders and China Clay merchants for a weighbridge capable of weighing lorry loads at St. Austell Station. Antiquated as it may appear, only horse vehicle loads are permitted to be weighed on the weighbridge at St. Austell Station. Even ton lorries are forbidden to weigh there. In this prohibition the G.W.R. have been unusually backward, and have lost thousands of tons of traffic in recent years with the growth of motor traffic in the transport of China Clay, coal, and other goods. The old weighbridge is now to be replaced by a powerful one capable of taking big as well as small mechanical vehicles. It will not be before it is needed.

Electro-Osmosis of China Clay

(From a Correspondent)

WHEN a clay is suspended in water it forms a colloidal "sol," the particles having a negative charge. Colloidal sols are flocculated by ions carrying contrary charges to that of the colloidal particles. Consequently the clay in the form of sol will be flocculated by the acids, deflocculated by the bases, and flocculated by colloids with contrary charge. The action of salts varies with their degree of dissociation. A suitable electrolyte will produce a stable suspension. If an electric current be passed through the clay in suspension mixed with a suitable electrolyte, the colloidal particles of clay will be drawn towards the anode, consisting, most conveniently, of a rotating cylinder on which the clay deposits. The deposited layer gradually increases and when it has attained sufficient thickness it is removed by a scraper as a solid mass.

Details of Process

The impurities which have a contrary charge are drawn towards the cathode and deposit in the lower part of the vessel. This process is that of electro-osmosis, which is employed for the treatment of China Clay in Czecho-Slovakia, at Chodau, near Karlsbad (Karlový Vary) by the Elektro-Osmose Aktien Gesellschaft. Mr. M. A. Granger, who visited this works, gives the following details in *La Céramique* (September, 1926):

The China stone is obtained near the works and crushed between two cylinders after which it is thrown into a drag, where it moves along against a current of water. The slip from the drag contains a considerable amount of fine sand and mica and is run into channels where it is freed from sand. The slip is then mixed with sodium silicate in the proportion of 10 litres of solution of 36° to 38° Baumé (e.g., a density of 1.332 to 1.357) per 10 metric tons of raw stone. The latter contains 24 per cent. of China Clay. If the percentage of clay varied the amount of silicate would have to be in corresponding proportion. As soon as the silicate is added the slip is ready for treatment and is conveyed to the osmosis machine which consists of a horizontal drum performing one revolution in 3 minutes 20 seconds. It has a diameter of 600 millimetres and a length of 1.43 metres, and is made of a 15 per cent. antimony-lead alloy. In 24 hours this machine produces 6.6 metric tons of China Clay with 10 to 12 per cent. moisture. The average consumption of electricity is 17.6 kilowatts per machine, with a current of 110 volts. The same principle has been applied to a press filter.

Results of the Method

When it leaves the osmosis machine the clay is in the form of plates or crust difficult to handle, and it is put into a mixer which reduces it to a paste. Then a draw-plate gives it the form of a hollow prism which is cut up into bricks. These hollow blocks dry much quicker and are conveyed on trucks to the dryer. When dry the China Clay is put into bags. The clay deposited with sand in the channels is separately collected and sold for paper making. This process can also be applied to other clays, but hitherto the most interesting results have been obtained with China Clay. Prices are considered too great for ordinary clays and it is probably this question which has hampered the works of Westerwald, near Montabaur, in Staudt.

The following are the results of analysis before and after osmosis:—

	Before Osmosis.			After.		
Silica	71.40	53.80	70.96	47.52	45.88	49
Alumina	20.56	29.95	20.51	39.95		38.41
Iron Oxide	1.14	1.70	1.49	1.70		1.19
Lime and magnesia						
Alkalis	—	3.11	0.92	0.73		0.89
Loss at red heat	6.80	11.14	—	12.40		10.60
Melting point with cones	27	28	29	33		32

The results given by electro-osmotic treatment are quite different from those obtained by washing. Whereas in the latter, there are considerable quantities of fine sand, the clay is obtained pure when treated by osmosis. Moreover, there is an action on the colloidal part of the kaolinite so that the most plastic substance is, as it were, extracted and the product is improved from the point of view of plasticity.

China Clay Notes and News

Ex-union Official Sued

At St. Austell County Court the Transport and General Workers' Union sued Charles Netherton, of Fowey, who was previously branch official of the Union at Fowey, for the non-payment of monies collected by him. His Honour Judge Gurdon made an order for the payment of £3 per month.

St. Austell Rates Reduction

At the St. Austell Parish Council meeting the Overseers reported that they had made a poor rate of 6s. 4d. in the pound, and a special expenses rate of 1s. in the pound for the ensuing half year, which was a reduction of 4d. in the pound, as compared with last year, the special expenses rate being then 1s. 4d. in the pound. Mr. Thomas called attention to the state of the road leading to Hallow, just off the main road at Bugle, and the Clerk was directed to write the G.W.R. stationmaster, Bugle, to have the surface cleaned up as the clay dropping from the wagons made it dangerous.

Effect of Coal Settlement

Expressing his views with regard to the influence the coal settlement would have upon the China Clay industry, Mr. W. H. Whiteway Wilkinson, of Whiteway and Co., clay merchants, Kingsteignton, Devon, said that the home market was practically dead and other markets very dull, and to continue to produce without a market meant an inroad on capital which could not continue indefinitely. If the coal dispute was really over, much would depend on the conditions of the settlement, but so far as the prospects of the China Clay industry were concerned he saw not the slightest sign of improvement during the present year, at any rate.

Presentation to a Clay-Worker

A presentation was made at the Trewheela China Clay Co. Works at Retew, St. Enoder, to Mr. Robert C. Grigg, of Ruthcross, by his fellow employees on the occasion of his departure for New Zealand. Mr. Grigg, who has been in the employ of the company for six years as an engine driver, has won the respect and esteem of all his colleagues, and in presenting him with a leather wallet all joined in conveying their good wishes for his welfare. Captain H. Bullock, in making the presentation, requested Mr. Grigg to accept, in addition to the wallet, a pocket Bible and hymn book, as a memento of his own personal esteem for him. Mr. H. T. Curtis paid a tribute on behalf of the employees.

Unemployment Situation, Mid and West Cornwall

The particulars of the numbers of unemployed in the Mid and West area, in the first week in December, are given below. It will be noticed that whereas the Redruth and Camborne totals are fairly steady, the figures at Falmouth and St. Austell have risen considerably of late. Falmouth tops the list with 1,150, and St. Austell has the second highest total, 571. Redruth has 403, Camborne 434, Falmouth 1,150, Fowey 176, Hayle 297, Helston 66, Newquay 66, Penzance 358, Perranporth 6, St. Columb 260, St. Austell 571, St. Just 228, and Truro 185. Of the above numbers 842 men, 16 boys, 98 women and 14 girls are known to be working short time or stood off temporarily, or are in casual employment.

China Clay Prospects

The coal strike was bound to have a damaging effect on our local China Clay industry, writes a correspondent. It is welcome news that the effect was not more damaging. There has been a smaller output which, in turn, of course, has meant reduced employment. Perhaps there will be a rebound in the other direction now that we are all getting back to work again. One can only wonder that the industries of the country which were so dependent upon coal have stood the strain as well as they have. It shows the powers of resistance which industry in the Old Country still possesses, and it is at the same time an indication that when general conditions improve, and we are all working together instead of fighting each other, we may have in the future a period of real prosperity. If it comes, China Clay will be likely to be among the early industries to benefit.

Town Planning of Clay District Deferred

In reply to criticisms as to why the Town Planning Committee of the St. Austell Rural Council desired to defer the town planning scheme, so far as it related to the clay district, the Clerk, Mr. A. S. Coldham, explained that the Committee had now found there were difficulties in the way of town planning in the whole district. There was also the question of cost. It was felt that now they had gone so far in issuing the necessary notices and advertisements of the schemes, it was hopeless to try to get the whole thing turned down, but if they were prepared to give an undertaking to town plan a part it was thought that the Ministry would be prepared to sanction the postponement of the rest. It is not surprising to those who are familiar with the diversity of the St. Austell district that now it is realised what a costly affair it would be, coupled with complicated questions relating to the China Clay industry, the Rural Council are desirous of dropping the scheme which affects the greater part of the district. There is something to be said for the town planning of a place like Mevagissey, which is a township to itself, and a place like St. Blazey, but when it comes to places like Tywardreath, Roche, Bugle, St. Dennis, St. Stephens and St. Mewan, which have compact areas surrounded by vast tracts of China Clay moorland and agricultural land, the difficulties are very great.

The Council, in adopting the larger area for town planning, were a trifle hasty and evidently did not consider sufficiently the complications of the matter. Under the Town Planning Act it is competent for a local authority to block out areas in particular parishes which shall be immune from the scheme, as, for instance, China Clay lands and agricultural lands that are remote from the possibility of building development.

China Clay Unemployment Relief Fund

There will be general regret at the necessity for the re-opening of the voluntary unemployment relief fund which was initiated at St. Austell on the occasion of the slump in the China Clay trade a few winters ago. The fund was of great assistance to genuine unemployed men in supplementing their income from other sources to enable them to tide over a period of depression. It was not large (£1,200) but it was sufficient to meet the immediate needs of a large number of families, seeing that when its operations ceased there was nearly £280 in hand. It is gratifying to note from the remarks of Captain Walter Light that there is no absolute distress in the China Clay area, but there is a distinct need for supplementary grants in cases where, as he says, men hardly know "which way to turn." The old system in the administration of relief which worked so well on the last occasion is to be revived. Local committees are to be set up to receive and investigate applications and, if the cases are worthy, to recommend them to the central committee for assistance.

The present unemployment position is directly due to the prolonged coal stoppage. China Clay firms in normal times, especially the bigger firms, are generally over rather than under-staffed on the production side, and have always a more or less floating staff of men engaged on development work in shaft sinking, level driving, overburden removal, incline extensions, and so forth. Through the tremendous drain on their resources, due to the abnormal price of coal, China Clay firms have had to reduce their labour costs to the barest necessity. This has meant the standing off of a large number of men who were engaged in development work and also of the men on production work who were surplus. This state of affairs reached its zenith at the time of the collapse of the coal dispute, on account of stringency in the coal supply position. Consequently the full effect of this is now at its height in the unemployment position, but after Christmas it is expected that with freer supplies of cheaper coal matters will improve and clay firms will be encouraged to restore their staffs to the full, to be ready for the trade boom which is expected early in the new year. It would be regrettable if, through the revival of the activities of the relief committee, the impression were to be encouraged that the present phase of the industrial position is any other than a temporary and passing phase of the aftermath of havoc caused by the coal dispute.

Death of Mr. Sidney Rowe

News has been received at Camborne, the home of his father, of the death, following an operation, of Mr. Sidney Rowe, an ex-student of the Camborne School of Mines who for 18 years had been an assayer of the Champion Reef Mine, Kolar Goldfield, India. Mr. Rowe, who was 42 years of age, leaves a widow and four children.

St. Austell Exile's £200 Gift

The Vicar of St. Austell, the Rev. E. Roberts, B.A., has been greatly surprised and gratified to receive the handsome gift of £200 towards the World Call Missions contributions from St. Austell parish. The donor wishes to remain anonymous, but the gift was sent in two £100 notes by a London bank. A World Call campaign has been conducted during the past several weeks by the various parishes in the Diocese of Truro, and it was as a result of the appeal made in St. Austell that the gift of £200 was made.

Supplies and Prices of China Clay

One of the leading China Clay producers has stated that there would be a shortage of clay all round for the next two or three months. "A great many of the works," he added, "have dried off all their stocks, which with foreign coal has cost double to do. Firms have been losing with fixed prices for their products, and will naturally continue to lose while supplying under contract, and the only way they can recoup themselves is by getting enhanced prices for stock lots. As far as can be seen the prospects for next year will be very good. There has been a heavy demand from the United States during the past month. There is certain to be a rise in the price of best clays, and the Americans are trying to get all they can this year. Low price clays are being sold at a loss in consequence of the cost of poor foreign coal as compared with the good Welsh coal ordinarily used. Some of the smaller works are more or less shut down and others are in a very bad state through lack of capital and consequent inability to obtain coal for drying."

Anomalous Flocculation of Clay

From time to time, notes have appeared in these columns in regard to work which is being done in elucidating the anomalous flocculation of clay. Dr. H. B. Oakley, of the Wellcome Tropical Research Laboratories, Khartoum, in a letter to *Nature* of November 6, stated that some further experiments had been performed which cleared up the discrepancies between the experiments previously described and those of Messrs. Kernack and Williamson. The following table gives the times required to flocculate a 0.1 per cent. purified clay suspension at various concentrations of sodium and calcium chlorides and hydroxides:—

Time required for flocculation.			
Concn. Ca ⁺ ion.	Ca(OH) ₂ .	CaCl ₂ .	Two equivalents of chlorides to one of hydroxide.
0.001	7 hours	14 min.	6 hours
0.002	28 min.	10 "	32 min.
0.003	2 "	7 "	12 "
0.004	1.5 "	6 "	4.5 "
0.005	1.5 "	6 "	3.5 "
0.010	1.5 "	6 "	1.5 "
0.014	1.5 "	6 "	1.5 "

Concn. Na ion.	NaOH.	NaCl.	NaCl : NaOH = 2:1.
0.05	2 hours	13 min.	2 hours
0.1	32 min.	13 "	32 min.
0.2	22 "	14 "	24 "
0.5	20 "	17 "	17 "
0.9	15 "	18 "	14 "

Deductions from Above Results

These results showed that calcium hydroxide was a less powerful coagulant than calcium chloride, and actually tended to stabilise a suspension containing the latter salt, provided that the time of flocculation was longer than about twelve minutes. If the concentration were such that coagulation

took place in 6 minutes or less, then calcium hydroxide flocculated more rapidly than the chloride at equivalent concentrations. The results for sodium, on the other hand, suggested that even this latter effect should not be called anomalous, as at a concentration 0.9 normal, sodium hydroxide was definitely a better flocculant than sodium chloride, while with the chloride-hydroxide mixture this effect started at a concentration of 0.5 normal.

A preliminary experiment with a 0.1 per cent. suspension of highly purified amorphous silica gave the following results for the concentration required to flocculate in the hour: for sodium chloride, no flocculation in 10 hours in 1 N solution, and for calcium chloride the same result; for sodium hydroxide 0.13 N; for calcium hydroxide, 0.0015 N. Thus both sodium and calcium hydroxides were far better flocculants than the corresponding chlorides. Dr. Oakley suggested that if the term "anomalous" must be used, it should be applied to the coagulation of silica by electrolytes rather than to the coagulating powers of calcium and sodium salts.

Effect of Electrolytes on Clay

In the course of some experiments made on a number of kaolins and Ball Clays the addition of electrolytes was found to exert varying effects on the cross-breaking strength, density, shrinkage, moulding properties, porosity and colour of different bodies. The cross-breaking strength of dry clays was increased by the admixture of from 0.8 to 3 per cent. of sodium hydroxide, sodium silicate, sodium carbonate, tannic acid and calcium hydroxide, the first named being more effective than the succeeding electrolytes. The strength of the Ball Clays was reduced by the use of small proportions of sulphuric acid.

As a rule the addition of alkalis and acids increased the density of dry mixtures, but when a larger amount than over 1 per cent. sodium hydroxide was used a reduction in density occurred. Except in the case of a secondary quality of kaolin a reduction occurred in shrinkage when from 1 to 2 per cent. of alkali was added to mixtures composed of 50 per cent. of clay and 50 per cent. of flint. A reduction in shrinkage also took place when sulphuric acid in large quantities was added, but the reverse action occurred when small proportions only were used.

Moulding of the plastic clay was unaffected when tannic acid or calcium hydroxide had been added to mixtures, whilst an adverse effect was experienced by the use of caustic soda, sodium silicate or sodium carbonate. When either of the three last named alkaline substances was employed the resultant ware had a tendency to crack on drying. Provided the amount did not exceed 2 per cent. the moulding properties of bodies were improved by the addition of sulphuric acid. Larger proportions, however, exerted a deleterious influence on them. Porosity was increased when acids were used whilst, as a rule, a decrease in that property took place when alkalis were employed, although calcium hydroxide consistently increased the porosity.

Addition of Caustic Soda

Admixtures of caustic soda reduced the burning shrinkage at cone 0.1, whilst on the other hand if over 0.8 per cent. of that alkali was employed the burning shrinkage increased. At cone 8 the strength of the burnt samples was increased by the use of either of the electrolytes already mentioned. The addition of alkali blackened one of the Ball Clays and simultaneously lowered the percentage of water required to develop the necessary plasticity. Some of the kaolins were agitated with the addition of a very dilute solution of sodium hydroxide, subsequently decanting the fluid with the clay in suspension. A small proportion of sulphuric acid was then added, just sufficient to neutralise the alkali already introduced. The presence of the acid also assisted in the deposition of the kaolins. Plasticity of the latter was sometimes increased by the foregoing treatment, and when it was desired to prevent this reduction in the percentage of acid used proved satisfactory. The employment of any excess over the requisite amount of acid was readily detected by the formation of a black scum or discoloration. Only by experiment was the necessary amount of sulphuric acid ascertained, as each kaolin required a different proportion depending on its characteristics; slightly less acid than soda being considered most successful as a general rule.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—November, 1926

Arrived.	Name.	Sailed.	Destination.
Nov. 1, S.S. Hayle		Nov. 6, Aberdeen	
Nov. 1, M.V. Pacific		Nov. 4, Charlestown	
Nov. 1, S.S. Pearl		Nov. 6, Emden	
Nov. 2, S.S. Zaanstroom		Nov. 9, Amsterdam	
Nov. 3, S.S. Beatty Rose		Nov. 4, Zeebrugge	
Nov. 3, M.V. Diugent		Nov. 6, Plymouth	
Nov. 4, M.V. Haldon		Nov. 9, London	
Nov. 4, S.V. Mary Miller		Nov. 23, Rochester	
Nov. 6, S.S. Southwick		Nov. 11, Penryn	
Nov. 7, S.S. Mallock		Nov. 12, Antwerp	
Nov. 8, S.S. Allenwerder		Nov. 11, Hamburg	
Nov. 8, S.S. Ravenspoint		Nov. 13, Genoa	
Nov. 8, S.V. Austrums		Nov. 23, Runcorn	
Nov. 9, S.S. Guelder Rose		Nov. 9, Dublin	
Nov. 9, S.S. Multistone		Nov. 11, Newcastle	
Nov. 9, S.S. Condar		Nov. 14, Plymouth	
Nov. 9, S.S. Wilhelmine		Nov. 12, Rotterdam	
Nov. 11, S.S. Corset Coast		Nov. 15, Liverpool	
Nov. 13, M.V. Eland		Nov. 23, Fredrikshald	
Nov. 13, S.S. Ribbledale		Nov. 18, Jersey	
Nov. 13, S.S. Wild Rose		Nov. 21, Weston Point	
Nov. 15, S.S. Ferndene		Nov. 24, Ridham	
Nov. 16, S.S. Alder		Nov. 14, Preston	
Nov. 16, S.S. Marita		Nov. 24, Antwerp	
Nov. 16, S.S. Gower Coast		Nov. 16, Preston	
Nov. 16, M.V. Anna Kirstine		Nov. 22, Gefle	
Nov. 17, S.S. Paddington		Nov. 24, Amsterdam	
Nov. 17, M.V. Johanna te Velde		Nov. 22, Hamburg	
Nov. 17, S.S. Surico		Nov. 24, Philadelphia	
Nov. 17, S.S. Blush Rose		Nov. 21, Preston	
Nov. 17, S.S. Hubbastone		Nov. 20, Brussels	
Nov. 17, S.S. Brier Rose		Nov. 21, Larnie	
Nov. 17, S.S. Guelder Rose		Nov. 21, Weston Point	
Nov. 17, S.S. Pansy		Nov. 22, Fleetwood	
Nov. 17, S.S. Primrose		Dec. 2, Preston	
Nov. 18, S.S. Outwood		Nov. 24, Alderney	
Nov. 18, S.S. Jelling		Nov. 26, Philadelphia	
Nov. 19, S.S. Scartho		Nov. 25, Bo'ness	
Nov. 19, S.S. Blairlogie		Nov. 30, Portland, Me.	
Nov. 19, S.S. Abercraig		Nov. 26, Leith	
Nov. 19, S.S. Joffre Rose		Nov. 20, Bruges	
Nov. 19, S.S. Linton		Nov. 29, Rouen	
Nov. 20, S.S. Fullerton Rose		Nov. 21, Dublin	
Nov. 22, S.S. Ciscar		Nov. 27, Genoa	
Nov. 22, M.V. J. T. & S.		Nov. 27, Runcorn	
Nov. 23, M.V. Sibille Naval		Nov. 27, Harburg	
Nov. 23, S.S. Rayford		Nov. 29, Methil	
Nov. 23, S.S. Norrix		Nov. 26, Grimsby	
Nov. 24, S.S. Yewbank		Dec. 1, Brussels	
Nov. 24, M.S. Maorilands		* Genoa	
Nov. 24, S.V. Falken		* Aarhus	
Nov. 24, S.S. Saxilby		Dec. 3, Portland, Me.	
Nov. 24, S.S. Admiral		Nov. 26, Dunkirk	
Nov. 25, S.V. Enns		Nov. 30, Hamburg	
Nov. 25, S.S. Eltham		Nov. 30, Liverpool	
Nov. 25, S.V. Ornen		* Drammen	
Nov. 25, S.V. Norden		* Oscarshamn	
Nov. 25, S.V. Alzina		Nov. 26, Truro	
Nov. 25, S.S. Sturdee Rose		Nov. 30, Runcorn	
Nov. 25, M.V. Advance		Nov. 30, Hamburg	
Nov. 28, S.S. Mallork		Dec. 3, Antwerp	
Nov. 28, M.V. Noordhaap		Dec. 3, Antwerp	
Nov. 28, M.V. Annie		Dec. 2, Salcombe	
Nov. 28, S.S. Westlea		* Philadelphia	
Nov. 28, S.S. Zaanstroom		Dec. 3, Amsterdam	
Nov. 29, S.V. Erhardt		* Charlestown	

* In Port.

Charlestown Shipping—November, 1926

Arrivals		
Date.	Vessel.	From
November 2	M.V. Pacific	Porthleven
November 8	S.S. Silver City	Penryn
November 9	R Passmore	Falmouth
November 24	S.S. Fox	Exmouth
November 25	Lady Rosebery	Torquay
November 26	Annie	Gweek
Sailings		
Date.	Vessel.	Destination.
November 1	Katie	London
November 2	Harvest King	Liverpool

November 2	Rossing	Goteborg
November 2	S.S. Meralie	Brussels
November 3	Fortuna	Goteborg
November 6	M.V. Pacific	Rochester
November 9	S.S. Silver City	Glasgow
November 17	R Passmore	Rochester
November 26	S.S. Fox	London
November 26	Lady Rosebery	Snodland
November 27	Annie	Plymouth

Par Harbour Shipping—November, 1926

Arrivals		
Date.	Vessel.	From
November 3	M.V. Isabella	Truro
November 3	M.V. Hope	Falmouth
November 9	M.V. Rochester Castle	Torquay
November 17	S.S. Matje	Terneuzen
November 19	S.S. Magrix	Penzance
November 19	M.V. Hope	Gweek
November 19	S.S. Hatchmere	London
November 28	S.S. Treleigh	Portreath
November 29	S.S. Trader	Kingsbridge

Sailings		
Date.	Vessel.	Destination.
November 1	M.V. Annie	Plymouth
November 3	S.V. Henrietta	Queenborough
November 3	M.V. Venturer	Antwerp
November 3	S.V. S. F. Pearce	Antwerp
November 3	S.S. Norrix	Hull
November 3	S.V. Denise M.	Rochefort
November 5	S.V. Clytia	Christiansund
November 6	S.S. Groningen	Antwerp
November 12	M.V. Isabella	Penarth
November 12	M.V. Hope	Penryn
November 22	S.S. Magrix	Rochester
November 23	S.V. Emma Ernest	Leith
November 23	M.V. Rochester Castle	Queenborough
November 23	S.S. Matje	Lancaster
November 23	M.V. Hope	Plymouth
November 23	S.S. Hatchmere	Newlyn
November 30	S.S. Treleigh	Penarth

Par Harbour Tide Table, January, 1927

(Greenwich Mean Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Saturday	1	3.9	2.36	11.5
Sunday	2	4.1	4.25	12.0
Monday	3	4.48	5.10	12.6
Tuesday	4	5.33	5.55	12.9
Wednesday	5	6.17	6.39	13.0
Thursday	6	7.1	7.23	13.1
Friday	7	7.45	8.7	12.11
Saturday	8	8.30	8.52	12.6
Sunday	9	9.15	9.40	12.0
Monday	10	10.6	10.34	11.5
Tuesday	11	11.3	11.34	10.11
Wednesday	12	—	0.7	10.8
Thursday	13	0.43	1.20	10.9
Friday	14	1.50	2.31	11.1
Saturday	15	3.5	3.37	11.7
Sunday	16	4.7	4.36	12.0
Monday	17	4.59	5.23	12.3
Tuesday	18	5.45	6.6	12.4
Wednesday	19	6.25	6.43	12.5
Thursday	20	7.0	7.17	12.4
Friday	21	7.23	7.48	12.1
Saturday	22	8.4	8.21	11.9
Sunday	23	8.37	8.54	11.5
Monday	24	9.11	9.28	10.11
Tuesday	25	9.46	10.5	10.5
Wednesday	26	10.26	10.50	10.0
Thursday	27	11.10	11.52	9.7
Friday	28	—	0.28	9.7
Saturday	29	1.6	1.45	10.0
Sunday	30	2.23	2.58	10.8
Monday	31	3.30	3.59	11.7

E. CLEMENS, Harbour Master.

China Clay Exports for November, 1926

A RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom, from the United Kingdom to each country of destination registered during the month ended November 30, 1926:—

COUNTY OF DESTINATION.	CHINA CLAY.	
	QUANTITY.	VALUE.
	Tons.	£
Finland	856	717
Sweden	2,292	3,223
Norway	1,380	1,826
Germany	3,172	6,994
Netherlands	4,689	9,634
Belgium	7,035	12,991
France	2,180	3,030
Spain	974	2,181
Italy	737	2,210
China	15	75
United States of America	22,184	44,227
Mexico	50	207
Colombia	1	5
Argentine Republic	10	68
Cape of Good Hope	3	26
Natal	1	7
Bombay via Other Ports	1,634	5,720
Madras	8	37
Bengal	25	105
Australia	16	148
Canada	154	500
Total	47,410	93,937

November Deliveries of China Clay

Signs of a Revival?

THE following are the details of the November deliveries. As regards China Clay, the amount was practically the same as that in October, the respective figures being 60,165 tons and 60,345 tons. As regards the eleven months ending November 30, the total of China Clay deliveries was 785,863, a drop of about 30,000 tons as compared with last year. The total deliveries of China Clay, Stone, and Ball Clay were above those of October:

Port.	China Clay.		China Stone.		Ball Clay.		Total.	
	1926.	1925.	1926.	1925.	1926.	1925.	1926.	1925.
Fowey ...	47,153	64,762	4,180	3,303	2,449	695	53,782	68,760
Par	2,466	4,003	142	240	—	—	2,608	4,243
Charlestown ..	2,389	4,298	—	—	—	—	2,389	4,298
Plymouth ..	1,493	1,145	—	37	—	—	1,493	1,182
Loe	140	199	—	—	—	—	140	199
Falmouth ..	130	120	—	—	—	—	130	120
Newham ..	—	223	—	—	—	—	—	223
Penzance ..	1,190	690	—	—	—	—	1,190	690
By rail: ...	5,204	4,510	—	—	—	—	5,204	4,510
November	60,165	79,947	4,322	3,580	2,449	695	66,936	84,222
Ten months	725,698	735,127	33,430	39,343	17,511	24,314	776,639	798,784
11 months	785,863	815,074	37,752	42,923	19,960	25,009	843,575	883,066

China Clay Imports for November, 1926

A RETURN showing the registered imports of China Clay (including China Stone) into Great Britain and Northern Ireland from the several countries of consignment during the month of November, 1926, indicates that the imports were nil.

Consistence of Cement Pastes, etc.

BUILDING Research Technical Paper No. 5—"The Consistence of Cement Pastes, Mortars, and Concrete," by N. Davey, B.Sc., A.M.Inst.C.E. (pp. 54, 2s.)—has just been issued by the Building Research Station of the Department of Scientific and Industrial Research. Among the conclusions reached by Mr. Davey are the following:—

"Consistence is a property which depends mainly on the following factors: (1) Water content, *i.e.*, percentage amount of water used in mixing; (2) sizes of the solid particles, including the fineness of grinding of the cement; (3) the nature of the solids, the shape of the particles, their absorptivity and solubility, and the amount of chemical action and the state of the resulting products; (4) temperature of the mixing water and of the resulting paste; (5) aeration of the cement; and (6) amount of working or mechanical mixing. It is preferably measured by (i.) The Flow Table for neat cement pastes and

mortars; (ii.) the slump method or the Flow Table method for concrete. No one specified consistence will give the best results under all conditions. Under laboratory conditions that consistence which produces a mixture of the maximum density gives maximum strength and minimum permeability. This is the consistence that it is most desirable to use when possible. In practice this consistence is not always convenient; it is usually a fairly stiff mixture and may be difficult to use except for mass work. For reinforced concrete work where the concrete has to be worked to fill the spaces between the steel bars, and between the bars and the shuttering, a thinner consistence is desirable. It is a controversial question whether a concrete should be tested under conditions which will give the best test results, or whether the concrete to be tested should have a consistence about equal to that which it would have in practice."

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

BILBERRY AND TRESSIBLE CLAY MINING CO., LTD., Teignmouth.—Registered November 13, £1,000 debentures, balance of £2,600; general charge. *£1,600. October 23, 1926.

BISHOP AND STONIER (1926), LTD., Hanley, china manufacturers.—Registered November 10, £2,000 2nd debenture to bank; general charge.

CRUTE (H. E.) AND CO. (TORQUAY), LTD., pottery manufacturers.—Registered November 5, mortgages to bank; charged on property in Teignmouth Road, St. Marychurch, with machinery, etc.

REDHILL TILE CO., LTD.—Registered November 24, debenture to bank; general charge. *£4,500. July 17, 1925.

RUBIAN ART POTTERY, LTD. (late H. K. BARKER AND CO., LTD.), Fenton.—Registered November 4, £750 further charge (supplemental to deeds dated October 4, 1923, and April 27, 1925) to Building Society; charged on Rubian Art Pottery, Park Road, Fenton. *£5,320. December 29, 1925.

Satisfaction

REDHILL TILE CO., LTD.—Satisfaction registered November 10, £800 (not ex.), registered September 13, 1926; also satisfactions registered November 23, £1,000 (not ex.), registered June 7, 1921; £500 (not ex.), registered December 3rd, 1921; and £2,000 (not ex.), registered August 16, 1922; also registered November 26, £600 (not ex.), registered October 16, 1926.

London Gazette, &c.

Companies Winding Up Voluntarily

SOUTHDOWN TILERIES, LTD. By special resolution, November 12, confirmed November 27. C. E. C. Nicholls, incorporated accountant, Avenue House, The Avenue, Eastbourne, appointed liquidator.

Partnerships Dissolved

SILVERDALE TILERIES COMPANY (Thomas Edward WALLEY and Frederick John ALSOP), brick and tile manufacturers, The Silverdale Tileries Works and the Rosemary Hill Tileries Works, Silverdale, in the county of Stafford, as from November 30, 1926, by mutual consent. Debts received by F. W. Carder, of F. Geen and Company, Stoke-on-Trent, chartered accountants. T. E. Walley will carry on business under the name of T. E. Walley at the Rosemary Hill Tileries Works, Silverdale. F. J. Alsop will carry on business under the name of the Silverdale Tileries Company at the Silverdale Tileries Works, Silverdale.

The **Dyestuffs** **Monthly Supplement**

A Section devoted to the Manufacture and Use of Dyes Published
in **THE CHEMICAL AGE** the Second Week of each Month



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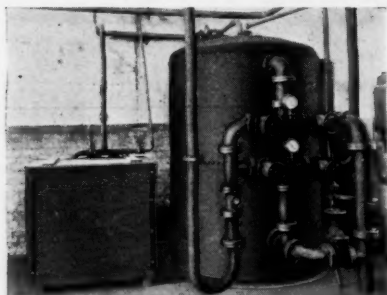
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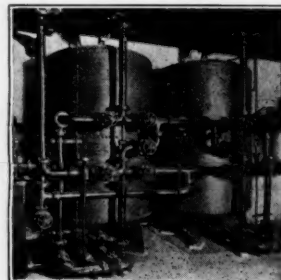
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Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

Dyestuff Developments

THE past month has witnessed two unusually interesting developments in connection with the dyestuffs industry. The first was the announcement, which THE CHEMICAL AGE was able to publish, of the concentration policy that is being pursued with such good results by the British Dyestuffs Corporation. The other was the official statement concerning the I.G. Dyestuffs, Ltd., the new German combine organised in this country for the sale and distribution of all I.G. products. Almost concurrently with the news of the concentration policy came the announcement of the considerable profits earned by the British Dyestuffs Corporation and the declaration of a dividend of 2½ per cent. Those shrewd and worldly minds who sense a stage in advance of the ordinary person the upward or downward drift of commercial concerns have already indicated their judgment by increased dealings in B.D.C. shares, which have appreciably advanced in price. Although Stock Exchange opinion is not much concerned with scientific or technical operations, it points in this case to one result. The period of suspicion and criticism has passed; public confidence has taken its place. We have ventured to suggest on more than one occasion that this new and growing confidence in the future of the B.D.C. will not be misplaced.

The Concentration Policy

THE policy of concentration which is to guide the operations of the B.D.C. for the future has been almost universally endorsed as sound. Quite mistakenly in some quarters it has been assumed that the discontinuance of certain works centres means a constriction of the company's activities. The real meaning is exactly the opposite. If in the future the operations are to be grouped around two great centres, obviously the outside centres have gradually to be discontinued. But they will be discontinued not in the sense of being closed but merely in the sense of being transferred and merged in the larger machine. The effect of these changes, when they are ultimately brought about, must inevitably be to increase efficiency, to reduce costs, and to strengthen the central control over operations. Although some rearrangement of staffs is inevitable in such circumstances, we believe that they will be carried out with every consideration for the personnel, and that the total amount of labour employed will not be affected to any serious extent.

I.G. Dyestuffs, Ltd.

THERE has been a good deal of speculation as to the real object of the formation of the new English company to undertake the sale and distribution of I.G. products. The immediate purpose is, of course, clear. This, like the other policy, is one of concentration for the purpose of cheapening the cost of sales and distribution and of increasing efficiency and central control. But while the Dyestuffs Act remains in operation there does not seem to be any very large scope for new developments. Every dyestuff product handled by the new company will have to be imported under licence as before, and the range and volume of British production is now such that the field open to foreign products is correspondingly restricted. It may

be that within these limits the service will be improved from the point of view both of the English consumer and of the German manufacturer, but that is as far as any benefit is likely to go.

The interesting question is how far, if at all, the new policy has been influenced by the fact that the Dyestuffs Act has a little over three years yet to run. It was originally fixed for a period of ten years, the assumption being that at the end of that period the British industry would have become so efficient as to stand on its own feet against foreign competition. But the renewal of the safeguarding legislation points to a tendency to continue more or less permanently restrictions set up for temporary needs, and we see no signs at present of any serious movement for the repeal of the Act. What can quite safely be said is that the objects for which the Act was passed have already been attained in a degree that few people would have ventured to predict, and if during the remaining period of the Act similar progress is maintained the nation may be trusted to see that the position gained is not lost a second time.

The Leading Spirit

WE have already given particulars about the directorate of the new German company. These indicate that it is largely composed of firms who have already had considerable experience in the merchanting in this country of German products. On that side the arrangements are pretty sure to be efficient. The leading spirit of the new company, however, is understood to be Dr. Phillipi, who has been largely responsible for the arrangements for bringing the new company into existence. We have heard it suggested that he may, in fact, become the managing director. Dr. Phillipi, of German nationality, like his colleague Mr. Selck, was before the war in charge of Cassella's English section. In that capacity he frequently visited England for business purposes and is therefore a quite well-known figure in British dyestuffs circles. We understand, in fact, that he is actually related to the members of one very big British industrial concern. For the present there is nothing to add to what has already been made public, but from time to time, no doubt, we shall have news as to the operations of the new company.

In addition to the details already published concerning the local agencies, we are informed that R. E. Sibbald, of Glasgow, is giving up his own business and joining the new company, with the same address as previously.

International Dyestuff Agreements

GERMAN Press reports state that the I.G. Farbenindustrie A.-G. has made an agreement with the "community of interests" of aniline dye manufacturers in Basle (Switzerland), comprising the Geigy Co., the Chemische Fabrik vorm. Sandoz, the Gesellschaft für Chemische Industrie, and their affiliated companies in Germany, France, Italy, England and America. It is likely that the agreements, which cover dyestuff production, will be extended further.

Colours for Viscose Artificial Silk

THE output of new British colours continues steadily, and a particularly large selection comes from the British

Dyestuffs Corporation. One of the largest and most interesting is the volume illustrating the application of direct, basic, sulphur and vat colours to viscose artificial silk. The range of colours is very comprehensive, and the effects produced on the dyed yarns are of great beauty and brilliance. Samples are shown of 132 direct colours, 20 after-treated, developed and coupled shades, 53 basic colours, 68 thionol colours, and 46 vat colours. While viscose is chosen as the medium for illustrating the shades to be obtained, the same colours are also suited for the dyeing of all allied qualities of artificial silk.

Of the various classes of dyestuffs employed, the direct colours are of the greatest importance, but the basic colours are indispensable for the production of the very brightest shades and are otherwise useful in special cases. The shades of the latter are, however, in general, less fast than those obtained by the use of direct dyes, and above all, in dyeing with basic colours, a more prolonged working of the goods is necessitated, a thing which, in the case of this valuable and somewhat sensitive material, is to be avoided as much as possible. The sulphur and vat colours are employed where the demands as regards fastness cannot be met by the direct colours.

A Peculiar Problem

IN some excellent notes on the dyeing processes most suitable for the various classes of colours and materials to which they have to be applied, it is stated that a problem peculiar to the dyeing of artificial silk of the viscose type is the result of certain difficulties connected with the manufacture of viscose thread. Without discussing the reasons for this, it is stated that the effect is that in the same batch of silk, even within the same skein, various portions of the thread are liable to show varying affinity for dyestuffs. Hence, hanks sometimes emerge from the dyebath with a very uneven appearance, and piece goods, both knitted and woven, may show stripes and markings of more heavily or more lightly dyed places termed "bar lines" or "weft bars," which seriously impair their saleability. While at present it is not practicable wholly to escape this undesirable effect, yet it can be avoided in certain cases and in others greatly mitigated in intensity by the choice of a suitable selection of dyes and dyeing methods. Otherwise the dyeing of viscose silk follows very closely on the lines suitable for cotton, due allowance being made for certain physical peculiarities of the artificial fibre.

Chrome Leather Colours

ANOTHER interesting addition to the B.D.C. colour index is the volume of samples of acid, direct, and basic colours dyed on full chrome leathers—calf, suede, and goat. There is a range of 84 shades, and some very rich effects are shown. As a rule chrome leathers are delivered to the dyer in either a wet state from the tanhouse or a damp state from the shaving machines. Occasionally, as in the case of suedes, the skins may be passed into the dyehouse in the dry state, after having been wheeled in order to raise a fine nap. No hard and fast rule can be laid down as to the best type of dyestuff to employ for any particular chrome leather, as much depends upon the preliminary processes of liming, tanning, etc. As a general rule, when penetration is desired, acid colours show decided advantages over chlorazol or basic colours. The chlorazol and chrome leather colours illustrated in the volume yield very level colours either in light or dark shades, but their penetration is rather inferior to that of acid colours. In certain cases, however, the addition of small quantities of acid colours when dyeing with chlorazol colours is found to give sufficient penetration. Where it is desired to preserve the "blue cut" of chrome leather chlorazol colours are of particular value. Of all the types of dyestuffs illustrated, chlorazol

or chrome leather colours are least affected by fat-liquoring with soap and oil. The basic colours are not so frequently employed as formerly. Their chief use is in the dyeing of full shades on a tannin mordant. They are also of interest for topping chlorazol colours for the purpose of obtaining full rich shades. The instructions accompanying this volume of B.D.C. colours on leather are very clear and full.

Autumn and Winter Shades

EIGHT samples of new autumn and winter shades for 1926-1927 are issued by the B.D.C., namely, Mauvette, Tulip Leaf Green, Sandalwood Fawn, Delphinium, Pimpernel, Copper Beech, Barleycorn, Burgundy, Golden Brown, and Mulberry. Reference is made to the success of the previous pattern sheets issued and the Corporation offer to give recipes for matching any further shades required on wool or any other material. In an explanatory note it is stated:—"Alizarine Ultra Blue B—the blue component given in the alternative recipes—is a new addition to our range and worthy of particular attention. By reason of its excellent fastness to perspiration and salt and its good solubility in acid combined with excellent fastness to light, it should, within a very short time, be indispensable to the dyer of better class ladies' dress goods, etc. The dyeing and fastness properties—alike excellent—of the alternative combination, Alizarine Ultra Blue B, Lissamine Fast Red BG, Lissamine Fast Yellow 2 G, reflect the latest and best achievement of the dyestuff industry."

Miscellaneous Colours

IN addition to their previous sulphur black colours, Hickson and Partners, Ltd., forward a new card showing their Sulphur Black R B Extra (powder), applied to cotton yarn, with particulars of the bath constituents, etc.

Three miscellaneous samples of the new colours issued by the B.D.C. are Alizarine Ultra Blue B, Monolite Red D Paste, and Solochrome Orange G.R. The first is confidently described by the producers as "the colour for which the dyer has waited for many years. It is the latest and best fast-to-light acid alizarine blue on the market; it is even faster to salt and perspiration than is Alizarine Delphinol S E N, while possessing the good acid solubility of Alizarine Delphinol B D N. Alizarine Ultra Blue B possesses excellent dyeing properties," and with it the dyer can now produce, without fear of complaint, blue shades fast to light, salt, and perspiration."

Monolite Red D Paste is a further addition to the B.D.C. Monolite series; it is of interest to printing ink manufacturers, particularly on account of its bluish undertone, and is also used as an oil colour and for paper surfacing. The paste gives the best results when precipitated as a barium lake with barium chloride.

A rich and showy addition to the B.D.C. range of chrome mordant colours is Solochrome Orange G. R. which "possesses very good fastness to light, milling, and dry steaming, whilst its very good levelling power renders it suitable for the dyeing of piece goods. This colour has a brighter shade than Alizarine Orange M Paste, to which it is at least equal in fastness properties, being, in the case of fastness to light, decidedly superior. It also possesses the additional advantage of being in powder form."

Strike Effects on Industry

THIS month's market reports indicate that the strike effects, though serious, are less damaging to the dyestuffs industry than was feared, and a confident feeling prevails that a better time is in store immediately the coal dispute is settled. Scarcity of coal has caused considerable difficulty, but foreign supplies are gradually becoming available, and some of the larger firms are adapting their boilers for oil fuel.

Growth of the American Dyestuffs Industry

A Review of Eight Years' Progress

The following review by Mr. W. F. Van Riper of the outstanding features in the development of the United States dyestuffs industry during the past eight years is reprinted from the "Du Pont Magazine."

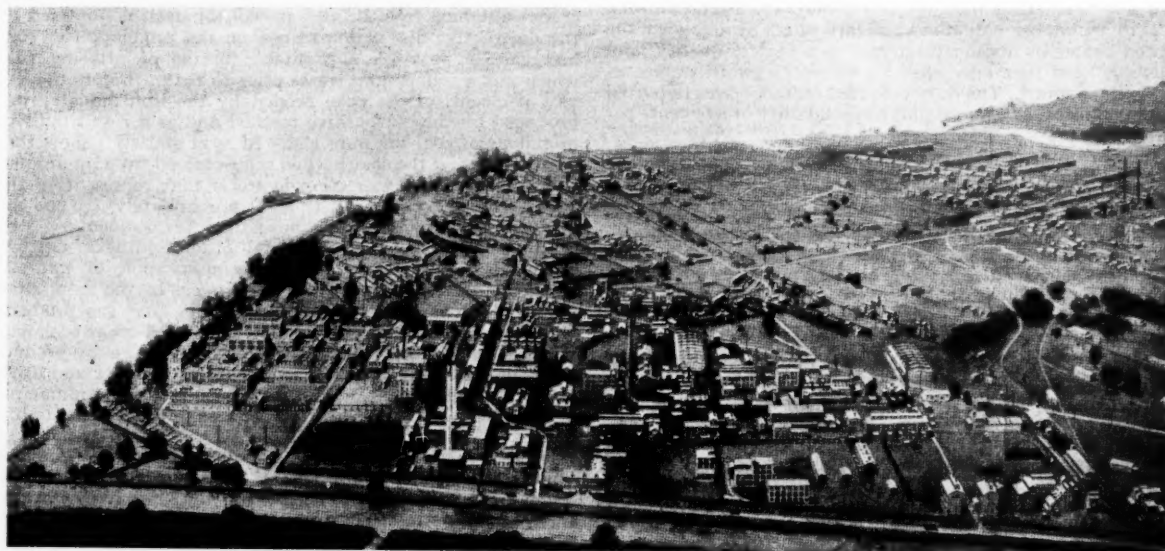
IN reviewing the progress of the American dyestuffs industry we can go back no farther than 1916 if we intend to confine ourselves to 100 per cent. American organic chemicals and labour. While statistics for the year 1914 show there were seven establishments producing dyestuffs, these plants, for the most part, merely assembled imported German intermediates and so collectively could not be termed a self-sustaining industry. Our absolute dependence on a foreign source of supply of dyestuffs had to be brought forcibly to the attention of colour consumers and potential manufacturers before an American dyestuff industry was possible.

From the beginning of the World War up to the passage of Title V in the Revenue Act of September 8, 1916, the dye-consuming industries of the country experienced a gradu-

panied by a corresponding decrease in the demand for the ordinary colours.

Then, too, they were brought face to face with the Government's war requirements of high explosives, steel and many other materials needed as well by the dye industry. A few of the chemicals commandeered by the Government were toluol, acetic acid, wood alcohol, chlorine, ammonia and caustic soda. It is easy to picture how the industry was hampered in its development as well as in the production of even those colours needed by the Army and Navy.

A still further handicap under which manufacturers were forced to operate was the difficulty of securing and retaining operators. Thousands of the ablest technically trained men were needed by the Army and Navy with the result that



GENERAL VIEW OF THE DU PONT DYEWORKE AT DEEPWATER POINT, NEW JERSEY, U.S.A. THE WILMINGTON HEAD-QUARTERS OF THE COMPANY ARE ON THE OPPOSITE SIDE OF THE RIVER DELAWARE.

ally increasing shortage of dyestuffs. While a few shipments were received from Germany, with Great Britain's permission, and while the few plants were producing all they could with their reserves of imported intermediates, the bulk obtainable was secured from all parts of the world, particularly the Far East.

The increased protection extended to dye producers during the latter part of 1916 attracted new manufacturers and allowed those already producing to increase their facilities many fold. On the whole, however, it was a period of acute dye shortage for the consumer, and one of great activity on the part of all those connected with dye production; cost of production and even quality were minor considerations, delivery being the one essential feature.

With the heavy demand for dyestuffs, it was quite natural for manufacturers to produce only those which required the least preliminary development and hence were the easiest to supply in large quantities. Lack of technical knowledge about difficult colours also forced them to produce the more fugitive types first. This situation corrected itself as time went on so that at the time the United States declared war on Germany, April 6, 1917, the American dye industry had seriously settled down to the large task before it.

But when the United States ceased being a neutral some great changes came in the industry. On one hand the dye manufacturers were faced with a sudden market for those colours suitable for the production of khaki cloth accom-

panied by many mistakes made and many plants were built only to be all but completely scrapped. The cost of experimentation during those days was a large item.

The entrance of the United States into the war, however, automatically aided the industry greatly in one way. The Trading-With-The-Enemy Act, passed October 6, 1917, gave authority to the Federal Trade Commission to issue licences under patents owned by enemy aliens. This allowed the dye producers to secure licences to manufacture the faster colours, particularly the vat dyes.

The industry continued to develop steadily even under the war-time restrictions, producing greater tonnage with a gradually increasing variety, so much so that during the fiscal year ending June 30, 1917, dyes valued at \$11,709,287 were exported, and for the 1918 fiscal year the value was \$16,921,888.

The United States Tariff Commission published in August, 1918, the first "Census of Dyes and Coal Tar Chemicals" for the calendar year 1917. It is from that volume that the following figures have been taken so as to give a more accurate picture of the extent of the industry during that critical year.

The Census states that 81 plants produced 45,977,246 lb. of dyestuffs during the year, or 136,380 lb. more than the total imports during the fiscal year of 1914. An analysis of this remarkable development, however, shows that while the production exceeded 1914 imports, the variety produced was

comparatively small. It can readily be seen that the output of the industry was a long way from being properly balanced by considering the fact that but 3 per cent. of the pre-war needs of vat colours were produced—and that all indigo.

With the signing of the Armistice on November 11, 1918, the industry in common with practically all others had to adjust itself again to peace-time conditions. This brought increased availability of essential raw materials and at greatly reduced prices. It also meant the necessity of increased efficiency so that costs could be lowered and the variety and quality of dyestuffs improved. The war had supplied an absolute embargo on importations, but with the coming of peace there was the certainty of foreign competition to be met.

The industry was fortunate in that it could regard the future with more assurance by reason of its ability to licence from the Chemical Foundation, Inc., any of the 4,500 odd basic German patents on drugs and dyes. Having this essential help the next important consideration was the necessity of having a more satisfactory and positive tariff protection.

Happily, the War Trade Board continued to function under the Trading-With-The-Enemy Act until the passage of the Dye and Chemical Control Act on May 27, 1921, allowing licences to import only those colours not "available in the United States on reasonable terms as to price, quality, and delivery," and then only after a consumer's sworn statement had been supplied. The duty collected on those dyes imported was 30 per cent. *ad valorem* plus a special duty of five cents per lb.

Another interesting feature of this special tariff act of 1916 was the provision—

but if, at the expiration of five years from the date of the passage of this Act, the President finds that there is not being manufactured or produced in the United States as much as 60 per centum in value of the domestic consumption of the articles mention in Groups II and III of Section 500, he shall by proclamation so declare, whereupon the special duties imposed by this section on such articles shall no longer be assessed, levied or collected.

Development of Industry

The manner in which the industry developed under such protection is shown in the United States Tariff Commissioner's letter of August 19, 1922, to the President, submitted in conformity with the latter's request of October 27, 1917.

It is therefore clear that during 1920 the domestic production of the articles enumerated in Groups II and III (intermediates and dyestuffs) was much in excess of 60 per cent. of the domestic consumption. Although complete statistical evidence as to production is not available for any later period than the calendar year 1920, it is apparent that the importation of these products has not increased during 1921 to such an extent that at the present time less than 60 per cent. in value of the domestic consumption is supplied by the domestic production. The facts, therefore, do not call for the issuance of a proclamation removing the specific duties under Section 501 of said Act.

Since 1917 the number of dyestuff plants has remained fairly constant. There has been, however, a marked diminution in the number of people employed by the industry. This improvement in efficiency has reflected itself in the steady decrease in the average selling price of dyestuffs until with the 1924 figure of 54 cents per lb. the dye-consuming industries were paying comparatively less for their colour than in 1914.

Let us dwell on that for a moment. In 1914 the average value per lb. of those dyestuffs produced in this country from German intermediates was 37 cents. This value covers the simpler colours only. The 1924 average selling price of 54 cents, however, represents the average price of over 90 per cent., by poundage, of the colours consumed in the country including vat dyes and all other relatively expensive types.

Price Levels

The Government's Bureau of Labour statistics show the purchasing power of the dollar to be 63 as compared with 100 for 1913. This means that the average of 37 cents is equivalent to 59 cents based on present purchasing power or 5 cents more than the industry's 1924 average.

To express it differently, despite the American valuation protection of the Tariff Act of 1922, which latter supplanted the Dye and Chemical Control Act, the severe competition within the domestic industry has forced the average price down to below the pre-war level.

Let us consider the output of the industry. The poundage production was 68,679,000 during 1924, having a computed value of \$37,086,660, or a total equal to only 62 per cent. of last year's profits of the United States Steel Corporation. It is estimated that the total capitalisation of the industry is not over \$125,000,000. As a whole, therefore, it is smaller than scores of separate companies engaged in other lines of production. Why, then, has Congress given it special protection in order to assure its continued existence as well as growth?

There are several important reasons. In the first place, approximately 70,000 separate establishments are dependent, directly or indirectly, on a continued supply of dyestuffs. No wonder it is called a "key industry."

Then, again, the dye industry is a self-supporting weapon of national defence. It was Germany's dyestuff plants that supplied the high explosives and toxic gases used not so long ago. Congress is determined that the United States shall also possess such a powerful weapon, if only to make continuance of peace surer.

Utilisation of Former Waste

Then, too, as the industry is founded on coal tar and the crudes obtained from it, and as coal tar itself is obtained by the destructive distillation of coal in the production of coke and gas, it provides a profitable means of utilising that which was a tremendous waste prior to 1917. Before the war 72.5 per cent. of the coke needed by the iron industry was produced by the old beehive method and as a result millions of gallons of coal tar were lost. In 1924 statistics show that 77.8 per cent. of the coke needed was obtained from by-product oven plants. An interesting figure is that representing the 1924 output of coal tar; it was approximately 470,000,000 gallons, with a sales value of more than \$21,000,000.

In 1924 "Census of Dyes and other Synthetic Organic Chemicals" we read: "In the conservation of national resources, the replacement of beehive ovens by the by-product variety, which recover the tar, ammonia, and gas products entirely wasted by the old beehive type, is of great economic significance for the following reasons: (1) The by-product ovens increase production of ammonia for fertiliser and other use; (2) the gas produced in these ovens is used for municipal lighting and industrial heating; and (3) the output of tar insures an abundant supply of coal tar for the preparation of crudes which serve as a basis of the domestic coal tar dye and chemical industry."

One cannot leave out of any such tabulation the importance of having American organic chemical laboratories wherein research chemists can discover new and more wonderful medicinals. Out of coal has come both heat and healing.

It is, however, mostly in connection with textiles that we hear of dyes and the dye industry, and it is rightly so, for what a different world it would be without the hundreds of beautiful shades seen on all varieties of textiles. The textile industry is practically dependent on an uninterrupted supply of dyestuffs.

The du Pont Company

Beginning with the production of indigo, back in 1917, the du Pont Company has endeavoured year after year to place at the disposal of the textile industry a constantly increasing choice of the purest of dyestuffs. Their present number runs into the hundreds, of a quality equal, and in many cases superior, to those produced anywhere in the world.

During the past year or two we have all noted the steady tendency toward extremely fast-coloured wash and dress goods. This has been made possible as the result of an increasing domestic production of the so-called vat-colours. Prolonged exposure to the sun, severe washing and even strong chlorine bleaching solutions have no appreciable effect on these superlative dyestuffs, hence textile manufacturers are turning more and more to their use; so much so in fact, that the words "guaranteed fast colours" are now appearing on some of the cheapest of cotton goods.

The du Pont Company has expended a large amount of time and money in the development of this group of fast dyes, and takes great satisfaction in the knowledge that even a gingham dress can now be obtained which retains its bright colours as long as the fibres hold together.

Dyestuffs manufacturers are several steps removed from the buying public, but there are few industries whose indirect influence is so plainly noticeable. Even the humblest citizen

can now clothe himself in materials dyed with American dyes, the colours of which possess a brilliancy and fastness not available to even the wealthiest of not many years ago. And the American dyestuffs industry is only eight years old.

In commenting on the earnest efforts of dyestuff manu-

facture and the great advances made by the industry, one eminent authority has expressed himself in the following words: "The dyestuff industry now stands justly high in the esteem of the public, and with continued support can safely predict an ultimate and complete triumph."

An Australian View of the British Dyestuffs Industry The Question of the Embargo

In view of the importance, from the point of view of the British Dyestuffs manufacturer, of keeping a hold on the Colonial markets, our readers will be interested in the article published below. It is reprinted from the "Industrial Australian and Mining Standard" for May 20, where it appeared as a leading article, under the title "British versus German Dyes."

WITH the exception of a few firms having a direct derivative interest in promoting the consumption in the Commonwealth of German dyes, the whole body of Australian manufacturers who are consumers of dyes use British dyes, and are quite satisfied to continue doing so for ever. We make this statement positively, with a thorough knowledge of the subject, and on the basis of incontestable evidence at our disposal, which, if necessary, can be produced to confound any contrary opinion. We have ample evidence, moreover, of an equally indisputable character, to prove that the great majority of Australian dye users are so content with the treatment they have received at the hands of British dye manufacturers that they are willing for the embargo on foreign dyestuffs to be perpetuated. These facts being so, what is the reason for the recent anonymous agitation for a removal of the embargo on German dyes, and who are the agitators? Also by what right do these nameless agitators send letters to the daily Press, pretending they are agitating in the interests of Australian manufacturers, and malignantly reflecting on the quality of the dyes manufactured in Britain? These are interesting questions. We shall endeavour to answer them.

The Embargo on Foreign Dyestuffs

In the first place, it is desirable to remind ourselves of the reasons that moved the Commonwealth Government to impose the embargo. When the Great War broke out not more than 5 per cent. of the dyestuffs used in the British Empire was manufactured within the Empire. The balance came from Germany, and at that time not only our Empire, but practically the whole world was dependent on German dyes. The first great consequence of the war was to compel England to establish vast chemical works similar to the German dyestuffs factories, which were equally adapted to the manufacture of dyes and of high explosives. All Germany's early successes in the field were essentially due to her great chemical dyestuffs factories, which devised and made the explosives and poison gases, etc., that supplied her armies with an incomparably greater power to deal out death and destruction than any of the Allies possessed.

As the struggle proceeded it resolved itself more and more into a chemical war, and it was not until Britain's chemical capacity was developed to a high state of efficiency that the Allies gained the ascendancy. The outstanding lesson of the war was that no nation can hope to defend itself successfully unless its self-contained chemical equipment is complete. It is, moreover, certain that the next world war will be even more a purely chemical war than that which ended in 1918. The British Empire learned this lesson at a cost of blood and treasure unparalleled in history. The lesson, however, was learned unforgettably, and learned not only by Britain, but by each of her Dominions.

Dyes in War and Peace

That is why, when at the close of the war Britain pointed out to us that the safety of the Empire depended on keeping her war-established chemical works going, the Commonwealth decided to assist the Mother Country by prohibiting the importation of German dyes. For the chief occupation of such chemical works in peace is the production of dyestuffs, and unless they can find a market for their commercial products, it would be impossible for them to maintain their efficiency as potential producers of indispensable war material.

Australian dye users approved the action of the Federal Government the more cordially because British dye manufacturers during the Great War kept them generously supplied

with dyes when supplies from other sources were absolutely unobtainable. To-day, British dyes are almost exclusively used by the principal consuming manufacturers throughout Australia; and the British consumption of British dyes has increased from 5 per cent. pre-war, to upwards of 80 per cent., despite the fact that the Reparations agreement with Germany practically made a large British consumption of German dyes compulsory. It is worth noting, however, that the House of Commons recently decided to take no further supplies of German dyes under the Reparation Clauses of the Peace Treaty. Britain's determination to support her own dyestuff industries, and to defend them from German competition, grows more rigid with passing time. Mr. Winston Churchill, in a recent official statement, declared the policy to be inviolable, because it is inextricably bound up with the safety of the nation. And it is. And if it is necessary to Britain it is infinitely more necessary to us, seeing that we are still dependent on Britain for the high explosives and complex gases that are essential to the defence of the Commonwealth.

Yet it has been seriously proposed that we should lift the embargo on German dyes, and thus strike a deadly blow at the defence of Australia, and the safety and economic welfare of the Empire. Who are the people who have ventured to put forward this grossly unpatriotic and suicidal suggestion? They do not name themselves. Can we discover their identity by a process of elimination? Let us see. Well, to begin, they are not to be found amongst the ranks of the host of big Australian manufacturers now using British dyes. All those gentlemen are completely satisfied with the price and quality of the British product, and are prepared to testify thereto if called upon, and to testify, furthermore, that most British dyes are equal, if not superior in quality, to German dyes.

I.G. Activities in Australia

It is not the Australian consumer, then, who seeks for the destruction of the British industry. And it is, certainly, not the British manufacturer of dyestuffs. Who else is interested? What about the German dye maker and his representatives in the Commonwealth? Perhaps this line of inquiry may lead to the truth. Here, at any rate, are a few significant facts. Quite recently there was formed at Frankfurt a mighty German Dyestuffs Super Trust, called the "Interessengemeinschaft Farbenindustrie Aktiengesellschaft," with a capital of 645,000,000 marks (equal to £34,000,000), which includes every dye maker in Germany. It was formed for the purpose of recapturing the world's market, and in particular to regain for German dye manufacturers their pre-war position in British markets.

The representatives of this Super Trust have been very active of late in Australia, and they have boasted quite openly that they intend to capture the Australian trade for Germany. It would undoubtedly be of great assistance to their aims if the embargo were removed. They might quite possibly, in that case, make good their boast by a campaign of underselling, and subsequently recover their losses by charging monopoly prices after having driven their British rivals out of business. Why, then, should they not agitate for the lifting of the embargo? And small blame to them if they are doing so. They are Germans, and are entitled as Germans to fight for German interests. But we are Australians, and it is our duty to fight for Australian and for British interests. Our course, therefore, is perfectly clear. The embargo must be inflexibly maintained.

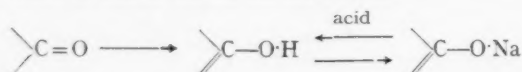
Dyes and their Application: Recent Technical Progress

By L. J. Hooley

(Scottish Dyes, Ltd., Grangemouth)

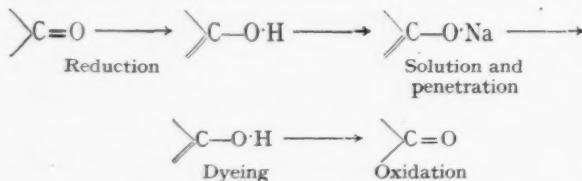
Dyeing Theory

In the normal process of vat dyeing, particularly with the anthraquinone colours, the dyestuff is rendered substantive to the fibre by reducing with alkaline hydrosulphite, which plays the dual rôle of reduction to the hydroxyl body and conversion of this to the soluble sodium salt.



If the vat thus formed be acidified, the process goes back as far as the middle stage, precipitation usually taking place at the same time. If cotton be then immersed in this suspension of the free leuco body, little or no dyeing takes place. It is easy to conclude from this that the sodium salt, and not the hydroxy compound itself, dyes the cotton. Kurt Brass and his collaborators have, however, brought forward a new explanation of the mechanism of the reaction which appears to show that the one above is erroneous. (*Z. angew. Ch.*, 1925, 853; *M. Textilb.*, 1925, 673.)

By carrying out the dyeing in an atmosphere of carbon dioxide and allowing this to exert its full effect before exposing to air or oxygen, he has been able to obtain dyeings approximately 50 per cent. stronger than by the ordinary method. And not only this, but the dyeing may be soaped before oxidation without loss of colour. The cotton, already impregnated with the sodium salt, has this converted by the acidic action of the carbon dioxide to the free leuco body, or as Kurt Brass calls it, the "leuco acid." This leuco acid then dyes on to the fibre, and after oxidation is converted to the original dyestuff. The function of the sodium salt, therefore, appears to be confined to that of enabling the dyestuff to come into proper contact with the fibre. An alternative experiment in confirmation consisted in carrying out the dyeing and oxidation in the entire absence of carbon dioxide and any acidic substance. Although apparently normal dyeing takes place under these conditions where the formation of the leuco-acid is excluded, the dyestuff was found to be completely washed off on soaping. The full vat dyeing process would, therefore, appear to be



Under the ordinary circumstances of dyeing the carbon dioxide present in the air acts as acid. The small concentration of this, however, combined with the presence of oxygen at the same time, causes some of the dyestuff to be oxidised without intermediate formation of the free leuco body, and the shade obtained is consequently weaker.

The fact that dyeing takes place with the free compound better than with the sodium salt accords with similar results which have been obtained with acetyl silk.

Reverting to the case cited at the beginning, where the free leuco body as obtained by the addition of acid to the vat does not dye, this may be explained as due to the dyestuff not having a proper degree of dispersion, which not only prevents penetration into the fibre, but may also hinder dyeing at the same time. It also illustrates an important point in connection with the fastness of dyestuffs, namely, that the greatest fastness to washing, soaping, rubbing and similar processes is generally obtained when the dyestuff is produced *in situ* on the fibre. The best example of this is seen when the azo colours synthesised on the fibre are compared with the direct azo colours. Similarly in vat dyeing

although the colour is not synthesised on the fibre, the actual compound which dyes the fibre is produced in contact with it. In the case of the azo colours, it may be objected that it is the distinction between insoluble and soluble which supplies the explanation of the difference in fastness; but insolubility alone is not a sufficient property for this type of fastness, as it is nearly always possible to produce dyeings with insoluble colours which, although satisfactory in other respects, do not withstand soaping.

Physical Changes on the Dyed Fibre

Some interesting results have recently been obtained on the behaviour of dyestuffs on the fibre. R. Haller (*Kolloid Z.* 38, pp. 248-253) has investigated the question of the reversible change in shade produced with some dyestuffs on hot ironing. The attractive hypothesis of J. Mueller that this is due to the conversion of a water containing form to an anhydrous one is stated to be insufficient for all the facts of the phenomena. According to Haller, who experimented with cotton, wool and acetate silk, using violet and blue benzidine dyes, these form colloidal solutions with the fibre, and have different degrees of dispersion under different conditions. The effect of ironing is to increase the dispersion, with a consequent change to a redder shade. It is probably to the portions of the dyestuffs having the lowest degree of dispersion that Mueller's explanation is the most applicable.

Another interesting change is that of some of the blue and violet dyes of the dibenzanthrone series, which redden on moistening, the original colour returning when dry.

The same author in conjunction with A. Ruperti (*Cellulosechem.*, 1925-6, 159-172) deals further with similar changes in the physical condition of dyestuffs. The effect of hot solutions, steaming, etc., is shown to cause agglomeration of the dispersed dyestuff, with a consequent deepening of colour, which is the opposite effect to that of ironing. The change was observed most easily with Para Red; less easily with Naphthol AS colours, and with difficulty with the vat colours. When the treatment with steam is prolonged, the colour migrates to the surface in the case of silk; but with cotton outwards to the cuticle and inwards to the lumen or central cavity, crystallisation sometimes taking place at the same time. The dyestuff which moves to the surface can be removed by washing. A similar change is described by B. Kayser (*M. Textilb.*, 1926, 437). Microscopic sections of cotton dyed with Naphthol AS colours are given.

Immediately after dyeing the colour is seen to be located principally in the cuticle, but after soaping it is found to have largely migrated to the inner wall of the lumen. A change in shade takes place at the same time; thus in the case of Naphthol AS/D dyed with Fast Red KB base, this is first yellowish red and then after soaping at the boil bluish-red. Illustrations of light exposure tests showing the great increase in light fastness which accompanied these are also given. The changes are probably intimately associated with the swelling of the cotton which takes place on soaping.

Dyestuff—Aminoacid Compounds

To the chemist whose bias is not towards the physical, cases of dyeings where a definite chemical combination can be established between the fibre and the colour are always attractive. By experimenting with simple derivatives of the aminoacid type, such as phenylalanine and sarcosine, P. Pfeiffer and O. Augern (*Z. angew. Ch.*, 1926, 39, 253) have obtained crystalline compounds with benzeneazophenol and benzeneazo-resorcinol. Molecular combination analogous to salt formation is thought to take place between the amino group of the acid and the hydroxy groups of the dyestuffs. If the hydroxy groups are alkylated or are absent similar compounds are not formed, nor could they be obtained with basic dyestuffs. Molecular combination of a somewhat similar type is supposed to take place in the dyeing of wool and silk.

Dyestuffs Markets : The Month's Business in Review

From Our Own Correspondents

Lancashire

Business has been much better than was to be anticipated in view of the rapidly diminishing stocks of coal. The latter are being eked out by the dyers with crude oil, and now that a certain amount of foreign coal is available, it would appear possible to carry on in a moderate way for some time.

During the month it was stated in the press that the Ellesmere Port and Huddersfield works of the British Dyestuffs Corporation were closed, and this probably is a fair indication of the effect of the coal stoppage on the dyestuff industry generally.

There have been two important announcements of general interest—the one of the British Dyestuffs Corporation's profit of a quarter of a million and the recommendation of a 2½ per cent. dividend, and the other of the formation of the I.G. Dyestuffs, Ltd., and the list of directors. The one would suggest that the reorganisation which is in process of being effected had already borne fruit, and the other that there is no intention on the part of the I.G. of allowing their share of the valuable British market to slip out of their hands through sheer neglect.

Both announcements are very interesting in view of the fact that the Dyestuffs Act has only three years to run, and it would seem highly probable that the I.G. has this in mind, as otherwise the cost of the selling organisation of I.G. Dyestuffs, Ltd., seems scarcely warranted by the amount of business which will be allowed it under the working of the Act.

It is understood that by taking over British Synthetics, Ltd., the British Alizarine Co. acquire the rights to make and sell certain of the so-called naphthols. Possibly it is part of a solution of a difficulty in which colour users found themselves, and they will now be free of the threat of legal proceedings arising from the infringement of an I.G. patent, which the use of British-made naphthols had previously entailed.

Yorkshire

Although at the time of writing the country continues to suffer under the disabilities of the coal stoppage, it would appear that the demand for colour for consumption has been distinctly in excess of expectation, from which one may assume that were the strike out of the way a distinct briskness might follow. A slight reduction in the number of unemployed textile workers in the Huddersfield district is another feature affording some little consolation, and the typical products of the mills of the heavy woollen district continue to find a good market in Canada, friezes being in particular demand.

Dyestuff makers and consumers alike endeavour to meet intermittent demands for their products and work by having recourse to local deposits of surface coal and pithead accumulations of more or less combustible waste; steam raising, however, proves a difficult matter and thoughts are turned to the fitting of oil burners.

The Gas Committee of the Leeds Corporation have considered suggestions with regard to the erection of a plant for the distillation of tar produced at the gasworks and a report on the subject from Mr. W. G. Adam, manager of the tar and chemical works of the Gas Light and Coke Co. As an alternative to embarkation on tar distillation the committee also had under consideration a scheme whereby all the big gas undertakings in West Yorkshire would co-operate in selling to recognised tar distillers. Among the gas-making authorities invited to co-operate are the Corporations of Leeds, Bradford, Halifax, and Huddersfield, and most of the gas companies in the West Riding. The Leeds Committee, which disposes of over 12,000 tons of tar annually, has been impressed, it is understood, with the arguments in favour of the co-operative scheme.

The British Dyestuffs Corporation, in pursuance of a policy of concentration, it is understood, intend eventually to close down or sell their Turnbridge (Huddersfield) works, originally owned by Read, Holliday and Sons, Ltd.

Nitrobenzene and Aniline Oil are no longer easily available; the price of the former has increased, 7d. being quoted for the "washed" quality, while the latter by one firm of makers is being carefully rationed, at pre-strike prices and amongst

home consumers only. The situation has arisen probably as a result of fuel shortage in the makers' works, coupled with a desire to conserve stocks of benzol as far as possible. A steady output of most other intermediates manufactured by local concerns continues at unaltered prices.

Owing to the closing down of coke ovens those sulphuric acid makers mainly concerned with the supplying of B.O.V. for the manufacture of sulphate of ammonia find themselves in difficulties with regard to storage, and in one case the chambers temporarily had to be stopped on that account. Lack of good fuel makes concentration of chamber acid a difficulty.

A new company has been formed under the style of "Wilkinson and Scott, Ltd.," with registered offices at 2, Lower Cobden Street, Longside Lane, Bradford, for the purpose of carrying on the business of dyeware, chemical, and soap manufacturers, merchants and agents; nominal capital, £6,000 in £1 shares.

Midlands

June has been a very quiet month for dyestuffs. It is the general opinion amongst hosiery manufacturers that a better time is in store immediately the coal dispute is settled. Dyers, being comparatively large consumers of fuel, have had a struggle to get sufficient coal to enable them to carry on, but supplies of imported coal are now available. A number of the large firms have adapted one or more of their boilers for oil fuel. Unfortunately, crude oil has been none too plentiful.

Wool spinners are working rather more than half time. Dyers of woollen hosiery have no bulk business but are engaged on autumn and winter samples.

Artificial silk hosiery dyers have plenty of small lots, but no weight; there are, however, inquiries for larger quantities of very cheap lines.

Natural silk hose are selling very badly. A great many machines for making these goods are being installed and it is not very encouraging to know that the few now running can more than meet the demand. It is to be hoped that when the coal crisis is settled and trade conditions become normal there will be a better demand and that this branch of the business will get established as a result of the Silk Tax.

Cotton hose are not a good feature; it is possible that artificial silk has almost completely superseded them. Sewing cotton is steady. Dyers of fadeless curtains are working, on the average, about half-time. Tanners are about the same as a month ago.

Prices for dyestuffs show little or no change. Aniline oil and aniline salt are very scarce on account of the shortage of benzol; most manufacturers are asking an advance of about ½d. per lb.

The local branch of the "Foreman Dyers' Guild" held their annual outing on June 26 at "The Hemplo," near Rugby. All kinds of sports, cricket, music, etc., were indulged in and a very enjoyable day was spent in glorious weather.

Scotland

The month of June has not shown very much difference from that of May, both orders and coal stocks getting lower. Offers of foreign coal have been at too high a figure to attract interest or be of any use except as a last necessity. The only satisfactory feature is that, taken as a whole, business is much healthier than it might have been under the circumstances, and there are still cases where manufacturers feel that the stoppage is the only obstacle between them and full orders. In Scotland conditions are best in the south; the tweed trade shows if anything some improvement, but there is a further set-back in the hosiery section. Dyers are reported as having a fair amount of work in hand and dyestuff sales have not weakened any further. The dyestuff works at Grangemouth are still running at good strength. By cutting off the processes most extravagant of coal and gas sufficient of these have been conserved to keep the majority of the remaining processes running.

The reorganisation of the various sales branches of the I.G. into the new single company, I.G. Dyestuffs, Ltd., is now an accomplished fact. R. E. Sibbald of Glasgow is giving up his own business and joining the new company, with the same address as previously.

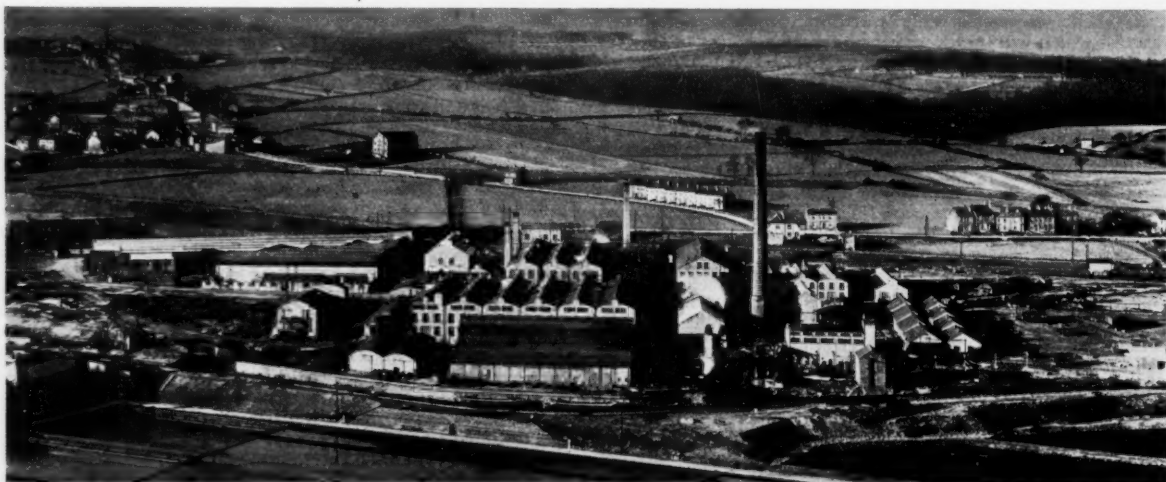
Around the Works : (6.)—L. B. Holliday and Co., Ltd.

THE name of Holliday is one which is honourably connected with the stirring discoveries of the very earliest days of the coal tar colour industry in this country, and therefore a firm bearing such a name cannot be regarded as a "parvenu" of the colour trade. The present head of L. B. Holliday and Co., Ltd., represents indeed the third generation of that name to be intimately connected with the manufacture of dyes.

Major Holliday's undertaking was, however, an entirely new beginning; and even as late as the autumn of 1915, the 60 acres site which the works now occupies still consisted of green fields. It was, therefore, not only a late start which the firm made, but, except in the way of experience, a start also from absolute zero, and it was not till the very end of 1917 that the first dyestuffs were marketed. The development of L. B. Holliday and Co., Ltd., since that date in the variety and quality of its products, is pretty well known to British users of dyes. It is a development which has certainly not lacked in boldness or enterprise. Circumstances have forced it from the beginning to be self-sustaining, owing nothing to financial assistance from public moneys. It is a stirring example of what may still be accomplished by individual effort. Messrs. Holliday have not confined their activities to certain classes of dyestuff, but have put on the market representatives of every known class, steadily increasing the number of their products, till they now number at least 250 chemically distinct dyestuffs.

L. B. Holliday and Co. have from the beginning realised the paramount importance of cultivating overseas markets for their goods, if the manufacture was to develop on sound economic lines and the products were to be sold at world prices. This is no easy task for a young firm, but the fact that they now have thriving sales organisations in almost every colour-consuming country and that in 1925, 25 per cent. of the production was sold abroad, shows the sound progress made in this direction, and is a testimony to the quality of the goods, practically all this having been sold in open competition with German and Swiss houses.

Moreover, in the belief that the establishment of a sound dyestuffs industry in this country is even more a matter of intermediates than of dyestuffs, L. B. Holliday and Co. have from the first set out to make most of the vitally important intermediate products themselves, and the list is now a very imposing one. Finally, it is noteworthy that, while naturally most of the activities of L. B. Holliday and Co. have been directed so far towards the covering of the field of known dyestuffs, nevertheless research along entirely new lines has never been forgotten; for an industry that means to be taken seriously must break new ground, staking out its own special claim in the colour world. If the results published to date are not very formidable (covering chiefly some novelties in the pyrazolone series), yet substantial fruit of an active policy in this direction will not be long delayed.



THE WORKS OF L. B. HOLLIDAY & CO., LTD., AT HUDDERSFIELD.

B.D.C. Annual Report

Working Costs Reduced

THE report of the directors of British Dyestuffs Corporation, Ltd., on the accounts for the year ended March 31, 1926, to be presented at the meeting of the company in Manchester on July 14, states that the trading results for the year show a net profit of £253,517. Out of this, £80,000 has been set aside for depreciation of plant and buildings, leaving £173,516. The dividend of 2½ per cent., already announced, will require £95,512 and £78,005 will be carried forward. The directors claim that during the year the quality of the company's products and the technical service which it renders to the colour-using industry have been substantially improved and extended. More dyestuffs were sold than in the previous period (17 months). The prices of dyestuffs fell considerably during the year, the average selling price being 5 6d. per lb. less than that for the previous period. On the other hand, the manufacturing costs have been reduced through increased technical and operative efficiency at the works.

Mention is made of the reduction of capital and reconstruction already referred to in these columns. Certificates for the new ordinary shares authorised to be issued in substitution for shares of the old denominations were available on May 10,

1926. The directors refer to the acquisition of a controlling interest in Scottish Dyes, Limited, the management of which will remain unaltered. Of the directorate, Mr. James Morton and Dr. Alfred Rée retire, and Field-Marshal Sir William Robertson and Professor W. H. Perkin also retire in rotation. All offer themselves for re-election.

Dyestuff Licences for June

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during June, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee. The total number of applications received during the month was 461, of which 396 were from merchants or importers. To these should be added 5 cases outstanding on May 31, making a total for the month of 466. These were dealt with as follows:—Granted 397 (of which 378 were dealt with within 7 days of receipt); referred to British makers of similar products 40 (of which 31 were dealt with within 7 days of receipt); referred to reparation supplies available, 6 (all dealt with within 2 days of receipt); outstanding on June 30, 23. Of the total of 466 applications received, 415, or 89 per cent., were dealt with within 7 days of receipt.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the *Dyestuffs Monthly Supplement* should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

Dyestuff Trade Conditions

It is satisfactory to learn from our monthly market reports that the effects of the coal stoppage continue to be far less adverse than was originally feared. In fact, what is picturesquely described as the "die-hard character" of the demand for dyestuff products is said to be a distinguishing feature of the market. Certainly, so far there is no sign of the complete paralysis that was threatened. Prices, however, of essential commodities required for dyestuff production show a very marked increase, and the shortage of benzene and toluene is particularly felt. Some feeling has been aroused by the prospect of the Bradford Corporation entering the field of sulphuric acid manufacture, the trade regarding this as an unwarranted competitive intrusion into the sphere of private enterprise.

New British and American Colours

Two new colours issued by the British Dyestuffs Corporation are Thional Direct Blue R and Chlorazol Fast Brown 2RK. The former is of the blue vat series of sulphur blue. It is of considerable interest for the production of full navy blues on loose cotton, cotton yarn, and cotton piece, and is suitable for dyeing in circulating machines, full "bloomy" shades being obtained without after-treatment. The fact that it is non-bronzing and non-scumming, together with good all-round fastness properties, makes it of special interest to the cotton piece and cotton yarn trades. Chlorazol Fast Brown 2RK is an addition to the B.D.C. range of direct browns. It gives reddish brown shades similar to but redder than Chlorazol Brown M, but possesses the advantage of decidedly more level dyeing, of being more soluble and faster to light, and of showing a much less marked change in shade after hot drying or hot pressing. Possessing very good fastness to light, it should be welcomed in the dyeing of all types of cotton materials, while its good solubility makes it specially suitable for machine dyeing.

New colours announced by the Du Pont Co., U.S.A., include Ponsol Red BN Double Paste, a new vat dyestuff, the chief use of which is on cotton for materials having to stand long exposure to light or repeated washings; Pontamine Fast Yellow B, mainly intended for dyeing tans, browns, olives, and similar shades on cotton piece goods; Pontamine Diazo Yellow 2GL, adaptable both to cotton yarns and pieces and to rayon and pure silk, and also capable of use as a ground for discharge work; and Pontamine Brilliant Violet B, which gives brilliant shades of bluish violet on cotton and rayon and reddish violet shades on real silk. The last three colours leave Celanese entirely unstained when the ordinary dyeing methods are used.

The Demand for Dyestuff Statistics

ATTENTION has again been drawn recently by the Colour Users' Association and others to the demand for official statistics of British dyestuff production and of dyestuff imports. In the United States this information is supplied in great detail and obtains wide publicity in the industry. As regards imports, tables of foreign dyes imported through New York and other ports are compiled monthly by the Chemical Division of the Bureau of Foreign and Domestic Commerce, in collaboration with the Chemical Division

of the Tariff Commission. These show in summary form the imports of synthetic dyes for each month of the year to date, with the comparative figures of quantity and value for 1925; monthly figures of coal tar dyes and colours and coal tar intermediates remaining in bond; the percentage of imported dyes according to country of shipment; imports of colour lakes, etc. In addition a complete detailed list of all dyes of coal tar origin imported is given. This gives the number of the dye—both the British Colour Index number and the Schultz number—the name of the dye and the manufacturer, and the quantity imported in pounds. The British companies represented in the most recent of these lists available are Brotherton and Co., British Alizarine Co., British Dyestuffs Corporation, Clayton Aniline Co., Colne Valley Dye and Chemical Co., L. B. Holliday and Co., and Scottish Dyes, Ltd.

In the production and sales table the dyestuffs are classified as follows:—Acid, basic, direct, lake and soluble spirit, mordant and chrome, sulphur, vats (including indigo), vats indigo and other vats, unclassified and special. For each of these classes the statistics give the domestic sales (weight and value) and the domestic production (quantity and percentage of total). The final figures for the year 1925, for example, give the following totals: U.S.A. sales, 79,303,451 lb., value \$37,468,332; U.S.A. production, 86,345,438 lb.; imports, 5,209,601 lb.

Bleaching and Dyeing Machinery

A NEW work of exceptional importance is announced by Ernest Benn, Ltd. It is entitled *Textile Bleaching, Dyeing, Printing, and Finishing Machinery* (50s., pp. 320), and the author is A. J. Hall, B.Sc., F.I.C., author of *Cotton Cellulose*, and chief chemist to the Silver Springs Bleaching and Dyeing Co., Ltd. This is the first book to describe the construction and performance of the machinery employed to-day for bleaching, dyeing, printing, and finishing textile fabrics, yarns and fibres. To ensure treating a subject of such great complexity in a definitely practical way, the author has arranged his material so that the reader may imagine himself taken over an ideal bleaching, dyeing, printing, and finishing works and successively shown the various types of machinery by which harsh and dirty textile materials are converted into products which are attractively coloured and pleasing to handle. The volume thus provides textile engineers, bleachers, dyers, printers, finishers, and chemists with a concise account of the construction and uses of the machinery employed in that branch of the textile industry in which during recent years such revolutionary strides have been taken. The volume includes over 300 examples of the most modern British and foreign textile machinery, a collection unique alike in number and variety. The letterpress and illustrations are in the best style, and the work is one that no up-to-date firm can well afford to exclude from its technical library.

Outline of the Work

THE contents are classified in three parts. Part I deals with fabrics, and describes in detail the machinery for preparing fabrics for dyeing, printing, and finishing, machinery for dyeing and mercerising, machinery for printing, and finishing machinery. In Part II, which deals with yarns, an account is given of machines for scouring,

bleaching, washing, and drying yarns, and machinery for dyeing and mercerising yarn. In Part III, which is devoted to loose fabrics and knitted materials, machinery is described for bleaching, dyeing, and drying loose fibres and for scouring, dyeing, drying, and finishing knitted goods. The descriptive matter is of the clearest and most practical kind, and the illustrations of the machinery, in line and half-tone, are exceptionally good and comprehensive. Even those engaged in the trade will be made to realise afresh what an immensely important and technical branch of the textile industry bleaching, dyeing, etc., has come to be, and the large degree in which the various processes are now performed by high-grade machinery.

Causes of Fading

IN the paper on "The Hygroscopic Relations of Colloidal Fibres" at the British Association, prepared by Dr. S. G. Barker, Mr. H. R. Hirst, and Mr. A. T. King—a report, in effect, on work done in the laboratories of the British Research Association for the Woollen and Worsted Industries, Leeds—reference was made to the work carried out on dyestuffs. Investigation showed that light was only one factor in the cause of fading of dyed material. The presence of oxygen and water was essential. It had been found that in many cases more fading occurred in England, where the atmospheric humidity was high, than in India over a longer period in a dry atmosphere. Dry wool fabrics which showed no fading when dry, faded rapidly when wet. The exact significance of this was being determined, but incidentally a point of importance was involved. In shop windows, where on sunny days fabrics were submitted to sunlight for a considerable time (fabrics which when exposed to open air and sun would not fade), it was found that they faded badly. It was found that the proprietor in an endeavour to maintain a cool atmosphere in the shop window had resorted to atmospheric spraying and free use of water, while the humidity due to the customers' bodies had aggravated the effect of bringing up the atmospheric humidity to a high value. The combination of high humidity and sunlight faded fabrics which under ordinary conditions would have been "fast to light."

Fifty Years in the Dye Industry

AN American correspondent reminds us that on June 18 Mr. Robert J. Keller, president of the Geigy Co., Inc., U.S.A., completed fifty years' connection with the company as well as the fiftieth anniversary of his business career. Although the firm has changed its name from time to time the name Geigy has been continuously on its books during these fifty years. Different departments of the company presented Mr. Keller with numerous gifts. He received from some of the older employees a gold fountain pen and an illuminated testimonial signed by all members of the organisation as a token of affection, and from the officers of the firm a Swiss platinum watch. At a luncheon to celebrate the occasion, Mr. Keller was offered the warmest congratulations and good wishes for continued good health and for his continuance as president of the Geigy Co. for many years in the future.

Dyestuff Users: International Co-operation

AT the recent annual meeting of the Colour Users' Association, Mr. Sutcliffe Smith made some very significant statements regarding possible international co-operation among colour users. The question arose out of the fact that the Association had sent a deputation to various Continental countries with a view to ascertaining the prices ruling for

dyestuffs. In the course of his statement Mr. Smith said: "Communication has been established with several leading users and associations, and if there is a desire on the part of the members to maintain and foster these conferences, your council will gladly take the necessary steps. A genuine desire has been expressed by several of the Continental users to establish a regular exchange of information, and the next step in this important matter is for your Association, if it so desires, to take the initial step by calling an international conference at which delegates from each country would attend."

Action and Reaction

MR. SMITH went on to point out that it was widely thought, in view of amalgamations of dye makers, present and future, that users ought to meet at regular intervals for the protection of their interests. This brings up some matters of great importance. The I.G. Farbenindustrie A.-G. of Germany, for example, is presumably both a dye maker and a dye user, its latter activity being connected with its great and increasing interest in the manufacture of artificial silk. It is known to be still hankering after an understanding with the British dyestuff manufacturers. Would it also have a part in any international conferences held by the colour users? At least one British dyestuffs firm would be in a similar position. These movements, and similar ones which have recently occurred in other industries, seem to indicate a steady drift towards the view that industry, both nationally and internationally, is to be regarded as a connected whole, and not as a series of disconnected entities.

Research

SOME important remarks were made by Mr. Smith regarding the vital importance of research. No great fundamental advance in the chemistry of dyestuffs, he said, had been made since Bohn discovered indanthrene in 1901. Research work had mainly been along known lines. He did not wish to decry what had been done by our chemists and engineers, who were second to none in the world, but there was still a great deal to be done in the advancement of technical methods. He raised the further point, which Professor Thorpe has also made, that no means existed of establishing contact between manufacturers of dyestuffs and intermediates and university researchers. It may, however, be pointed out that the British Dyestuffs Corporation has begun to deal with one phase of this matter by its scheme of student training. While this may not cover the question raised by Mr. Smith, it will probably have the effect of bringing into being a class of worker who will act as an unofficial liaison officer between industry and the universities.

Dyestuffs Licences for July

ACCORDING to the monthly statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during July, furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee, the total number of applications received during the month was 541, of which 479 were from merchants or importers. To these should be added 23 cases outstanding on June 30, making a total for the month of 564. These were dealt with as follows:—Granted, 493 (of which 470 were dealt with within 7 days of receipt); referred to British makers of similar products, 47 (of which 38 were dealt with within 7 days of receipt); referred to reparation supplies available, 15 (all of which were dealt with within 2 days of receipt); outstanding on July 31, 9. Of the total of 564 applications received, 523 or 93 per cent. were dealt with within 7 days of receipt.

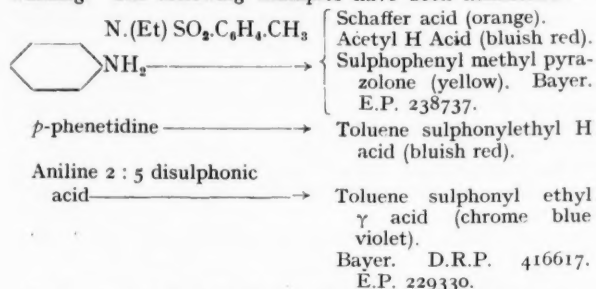
Recent Developments in Azo Dyestuffs

By Stanley C. Bate, B.Sc., F.I.C.

During the past twelve months a large number of patents relating to azo dyestuffs have been published. Some of these are merely developments, with possible slight improvements, of colours that are already well known; but, as the writer shows, a number of them undoubtedly are of interest and value because of the novelty of the intermediates described.

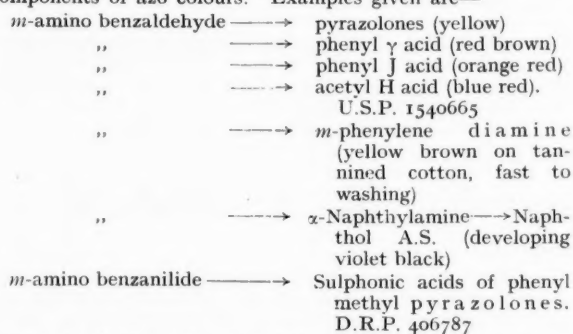
If an examination is made of the specifications recently published in connection with azo dyestuffs, it will be found that chief attention has been given to the mordant colours, with which the effort to obtain chrome colours suitable for calico printing has resulted in many derivatives of a novel type being described.

Referring first to acid azo dyestuffs, it is claimed that the introduction of a large acid group, such as the toluene sulphonyl, together with an alkyl group, into an amino group of a second component enhances the fastness to light and washing. The following examples have been mentioned:—



The preparation of these new intermediates is described.

The firm of Meister, Lucius, and Co. have described the use of *m*-amino benzaldehyde and *m*-amino benzanilide as first components of azo colours. Examples given are—



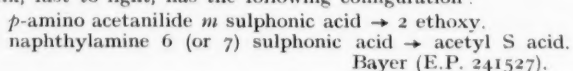
A somewhat novel method for the preparation of azo colours has been the subject of an American patent (U.S.P. 1547526). Carbazol is converted into its disulphonic acid by the action of hot sulphuric acid, and is then converted into *p*-nitroso carbazol disulphonic acid by the action of sodium nitrite. This is condensed with primary aromatic amines with the formation of azo dyestuffs.

Amine.	Colour.
Benzidine	Yellow
<i>p</i> -nitraniline	Golden brown
Amino azo benzene	Red brown
<i>p</i> -toluidine	Green yellow
H acid	Violet

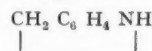
It has been found that α naphthylsulphamic acid (C₁₀H₇.NH.SO₃H)

couples quantitatively in the 4 position, and is therefore better than α-naphthylamine as a second component in disazo dyes. The N-sulphonic group is easily removed by warm dilute acids. The couplings with benzidine, etc., may be diazotised on the fibre directly without separate hydrolysis. Bayer (E.P. 238683).

A dyestuff which is claimed to give bright green shades on silk, fast to light, has the following configuration:



When a primary aromatic amine is treated with an equimolecular quantity of formaldehyde, a substance is formed which, it is stated, may be regarded as the anhydride of an amino benzyl alcohol, though this is very doubtful:



This substance is diazotisable, and the product of coupling the diazo compound with sulphophenyl methyl pyrazolone, dyes wool in clear yellow shades fast to milling (B.D.C. E.P. 243115).

Another new intermediate is *pp*'-diamino diphenyl ketone; the products of the coupling of the tetrazotised ketone with the usual end components such as H, J, R acids yield dyes stated to be remarkable for their fastness (U.S.P. 1472333 and 1472334).

In the class of mordant azo dyestuffs, the number of patents taken out recently has been very large.

Of these, many describe colours of the Palatine Chrome Violet type—i.e., obtained from *o*-amino phenol derivatives diazotised and coupled with various intermediates.

Some of the examples given are quoted here:—

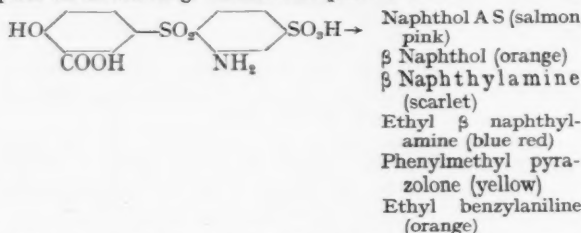
<i>o</i> -amino naphthol	1 naphthol 8 sulphonamide. S.C.I. Basle. D.R.P. Ann.G. 60049.
2 amino 1 naphthol 8 sulphonamide 4 sulphonic acid	naphthols and pyrazolones. S.C.I. Basle. E.P. 231149.
<i>o</i> -amino phenol and derivatives	1:4, 1:5, 1:8 or 2:6 naphthol sulphonamides or their sulphonic acids. S.C.I. Basle. E.P. 232620.
<i>o</i> -amino phenol and derivatives	1α or 1β naphthyl 3 methyl pyrazolone. A.G.F.A. E.P. 232629.
<i>o</i> -amino phenol and derivatives	→ resorcylic acid (chrome printing browns). S.C.I. Basle. U.S.P. 1529927.
<i>o</i> -amino phenol and derivatives	→ Phenyl methyl pyrazolones containing the SO ₂ NH ₂ group in the phenyl nucleus in the meta position. The chrome compounds give orange to red shades. S.C.I. Basle. U.S.P. 1529995.

It is stated that dyestuffs from 1 amino 2 naphthol 4 sulphonic acid (1:2:4 acid) and pyrazolones are improved in fastness to washing by the introduction of an esterified hydroxy group in the 6 or 7 position. The esterification of 6 hydroxy naphthalene 1:2 diazo oxide 4 sulphonic acid with acetic anhydride is described, also of the nitrated diazo oxide from 2:7 dihydroxy 1 naphthylamine 4 sulphonic acid with toluene sulphonyl chloride. A.G.F.A., E.P. 237594.

Some novel intermediates have been described for the preparation of mordant azo colours.

Aromatic *o*-hydroxycarboxysulphochlorides, such as salicylic acid sulphochloride, may be reduced to the corresponding sulphinic acids. These are condensed with aromatic nitro compounds having a labile halogen atom, such as 4 chloro 3 nitro benzene sulphonic acid, yielding nitro sulphones. The amino sulphones, obtained from these by reduction, on diazotisation and coupling with the usual end components, yield dyestuffs having the chrome fixing group isolated from the

chromophoric group, so that very little change in shade takes place on mordanting. Some examples are:—



Disazo dyes, also colours from the diamino sulphone (Bismarck Brown type) can be obtained. B.D.C. E.P. 245865.

3 Hydroxy naphthalene 1 : 8 dicarboxylic acid when coupled with diazo compounds is stated to give colours with good fastness properties. S.C.I. Basle. E.P. 226797.

Red, violet to black dyestuffs are obtained by coupling diazo compounds with substituted amides of β oxy naphthoic acid prepared from mono or diamino carbazol. M.L.B. E.P. 228913.

Chrome reds of good fastness for cotton printing are obtained by coupling *m*-amino benzene azo salicylic acid (made from *m*-nitraniline → salicylic acid, reduced) with acetyl K acid, acetyl S acid or acetyl H acid. Bayer. E.P. 231885.

A golden yellow colour of very pure shade is said to be obtained by coupling tetrazotised benzidine 2,2' disulphonic acid with 3 methoxy salicylic acid. Durand D.R.P. 413563.

Another pure yellow colour patented recently is that obtained by diazotising β naphthylamine 4 : 5 dicarboxylic acid and coupling with salicylic acid. S.C.I. Basle. Sw. P. 112532.

β Naphthol 4 : 5 dicarboxylic acid has also been used; coupled with diazotised aniline it gives a chrome brown; with 3 amino 5 sulpho salicylic acid a chrome or copper violet; with nitro 1 : 2 : 4 acid a chrome dark green. S.C.I. Basle. E.P. 226797.

Amino thioethers, obtained by the reduction and alkylation of aromatic disulphides, have been described as azo intermediates. The disulphides are prepared by the action of sodium sulphide (Na₂S₂) on *o* and *p* chloro nitro benzene, 2 : 5 dichloro nitro benzene and 4 chloro nitro benzene 3 sulphonic acid. Chrome greenish yellows of good fastness

are obtained by coupling the diazotised amino thioethers with salicylic acid. B.D.C. E.P. 235334.

When 1 amino 2 hydroxy 3 carboxy naphthalene 6 sulphonic acid is diazotised and coupled with pyrazolones, preferably containing a carboxy group, such as 3' carboxy 3 methyl pyrazolone, fast pink to blue red colours are obtained suitable for calico printing. B.D.C. E.P. 242061.

A few new amines have been proposed for the preparation of pyrazolones via the hydrazines. Examples are 2 chloro aniline 5 sulphonic acid. Nat. Aniline Co. U.S.P. 1511074; 2 : 5 dichloro aniline 3 sulphonic acid. Sandoz. U.S.P. 1539437; β naphthylamine 6 : 8 disulphonic acid (dye of tartrazine class). Holliday. E.P. 225097.

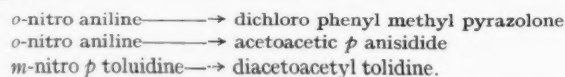
In the class of developed or ice colours, the following have been the principal developments.

Fastness to kier boiling is said to be attained by coupling a diazo compound, which may or may not be halogen substituted, with the 4 chloro 3 toluidide of β oxynaphthoic acid. Gries. Elek. E.P. 201712.

The formation of the pyridinium derivatives of compounds of the Naphthol A S series has been described and the utilisation of such compounds in the formation of colours developed on the fibre. Brit. Synthetics Co. E.P. 230920.

Fast claret shades are obtained by diazotising 4 benzoyl-amino 2 anisidine (prepared by benzoylating 2 nitro *p* anisidine and reducing) and coupling on the fibre with Naphthol A.S., etc. M.L.B. E.P. 231529.

The range of these colours is extended to yellows by using pyrazolones or acetoacetic arylides; some examples quoted are:—



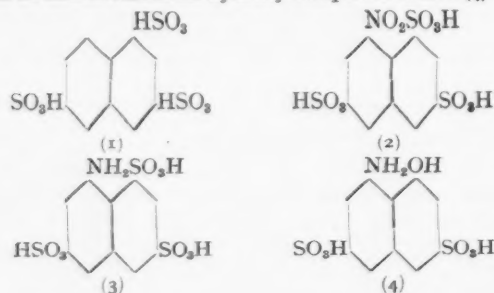
Gries. Elek. E.P. 217594.

Diamino diaryl methanes, obtained by the action of formaldehyde on primary aromatic amines (*o*-anisidine, aniline, etc.) in acid solution, have a distinct affinity for cotton and may be tetrazotised and coupled on fibre. The *o*-anisidine derivative developed with β naphthol gives a fast blue red. Diamino diphenyl methane, treated on the fibre with formaldehyde, then diazotised and coupled with β naphthol gives a fast bright orange. Haefely. E.P. 239634.

Basic Intermediates for Dyestuffs: No. 1.—H-Acid

By "Consultant"

H-ACID, one of the most valuable intermediates that the dyestuffs industry has to draw upon, is 8-amino-1-naphthol-3 : 6-disulphonic acid. The raw material for its manufacture is, of course, naphthalene, of which there is a plentiful and assured supply, so that the question of production resolves itself into an inquiry into the optimum conditions for the transformation of the raw material into the finished intermediate. Theoretically the manufacture of H-acid involves four stages. The naphthalene is first sulphonated to give the 1 : 3 : 6 trisulphonic acid (1) followed in the second stage by nitration, which takes place in the position eight. A simple reduction of the 8-nitronaphthalene-1 : 3 : 6-trisulphonic acid (2) to the amino compound constitutes the third stage. The product of this reaction is the well known "Koch" acid (8-aminonaphthalene, 1 : 3 : 6-trisulphonic acid) (3), and yields on caustic fusion the hydroxy-compound H-acid (4).



Practically, the problem is a comparatively difficult one, although in this preparation the use of evaporation, liming, and the concentration of weak liquors—the usual costly features of intermediate manufacture—are not in evidence.

The direct method of sulphonation in one stage with fuming acid is not favoured for the conversion of naphthalene into its 1 : 3 : 6 sulpho derivative, since the yield is very low, owing to the formation of various other sulpho derivatives. The method used at the present time is that in which the sulphonation is performed in two stages, naphthalene-β-sulphonic acid being produced as an intermediate stage. This serves not only to decrease the amount of fuming acid required, but considerably to increase the yield. In the first stage naphthalene together with one and a half times its weight of 100 per cent. acid are charged into the sulphonator, which is furnished with the usual stirring and heating devices. The charge for each sulphonator weighs about 12 cwt. The charge is then heated with continuous stirring for eight hours at a temperature of 160° C., the sulphonating pot being heated in most works by producer-gas. It is during this period that the naphthalene is converted to the β-sulphonic acid. Before continuing with the sulphonation the pot is allowed to cool, after which oleum is added in sufficient quantity to complete the sulphonation. For a charge of the above-mentioned weight about 5½ cwt. of SO₃ is necessary. Agitation is, of course, continued throughout the addition of the oleum, and the stirring is continued until all the β-sulphonic acid has been converted into the 1 : 6 disulphonic acid. This part of the operation requires no heating, but in order to bring about the final conversion to the trisulphonic acid the charge is

again raised to the temperature of 160° C. No isolation of the trisulphonic acid is necessary, since the charge sets on cooling to a gelatinous paste which can be blown into the vats ready for nitration.

Nitration is a comparatively simple operation, although extreme care must be taken to avoid a rise in temperature. The nitration takes place smoothly and there is no need to add the acid continuously. The exact weight of acid (calculated on a 100 per cent. basis) required for the complete nitration of the charge is run in and the whole mass stirred vigorously, and cooled by cold water coils until the nitration is complete, when the whole charge is turned out into about eighteen times its weight of water. This gives an acid liquor containing the nitronaphthalenetrisulphonic acid which can be reduced straight away to the amino compound. The usual reduction agent—iron turnings—is used, and is fed into the liquor in portions, continuous stirring being maintained throughout the reduction. The reduction is attended by the evolution of nitrous fumes which are collected by means of hoods and ducts and utilised in the production of vitriol. The amount of iron (about 11 cwt. for a charge of the size previously mentioned) is carefully calculated in order that no unchanged nitro compound remains, and the Koch acid obtained is salted out of the filtered liquor as the sodium salt, which is filtered off. Various other methods have been introduced on a comparatively small scale for the reduction of the nitro-compound to the Koch acid, but none, at the present stage of industrial chemical evolution, are as economical as the iron-acid reduction. They comprise an electrolytic reduction, on the continuous current circulating cell principle, and also the use of hydrogen gas in the presence of catalytic nickel, under pressure.

The caustic fusion is probably the most difficult part of the whole process, since the slightest variation in the strength of the caustic liquor used, may entail the splitting off of the NH_2 group and its replacement by $-\text{OH}$, giving the useless dioxy

compound. A small part of the Koch acid always gives this dioxy compound, but the presence of more than a trace seriously injures the quality of the H-acid for dyestuff purposes. The actual strength used is from 38–39 per cent. (NaOH in water), and the quantity is calculated on the basis that each molecular proportion of Koch acid sodium salt requires eight molecular proportions of caustic soda. The Koch acid sodium salt and the caustic soda are charged into an autoclave, and heated to 180°–200° C. at a pressure of about 80 lb./sq. in. for about five hours. The finished melt is blown over while still liquid into a vat of water and neutralised by the addition of dilute hydrochloric acid. In actual practice the neutralisation is stopped when the liquor is still faintly alkaline, and the latter filtered in order to remove insoluble matter which would otherwise get into the H-acid. The filtered liquor is then passed into a vat, and strong hydrochloric acid added. The sulphite formed during the fusion is thereby decomposed and sulphur dioxide liberated. This gas is in the most modern plants "economised" and utilised for the preparation of vitriol. When strongly acid the liquor is heated to boiling, usually by means of live steam, to get rid of any residual sulphur dioxide and the liquor allowed to cool. The H-acid separates on cooling and is filtered off, dried in trays very rapidly, and packed.

Since each bath of H-acid contains a variable percentage of the true acid, an analysis is necessary in order that sales may be conducted on the usual 100 per cent. basis. It is possible to estimate the amount of H-acid by means of a titration with sodium nitrite in order to ascertain the amount of NH_2 group, while a fair idea of the total amount of various acids present can be obtained by a coupling reaction.

H-acid, apart from other branches, is of paramount importance in the production of direct cotton dyes, among which may be mentioned Chlorazol Black E (extra), the Lanacyl Blues and Violets, Naphthol Blue-Black, Acid Black, Chloramine Green, etc.

Dyestuff and Coal-tar Product Imports into America A Decrease on the 1925 Figures for Dyestuffs

THERE is evident just now the customary falling off in the imports of coal-tar dyes, intermediates, etc., always found during the summer when the textile industry is working on part time. The peak for imports of synthetic dyestuffs so far this year was in March when the quantity reached 487,804 lbs., and the value \$435,891. The highest value for the year was in February when 479,027 lbs. were imported, although the value climbed above the March figure of \$435,891 to \$477,255. Since March the quantity and value have declined steadily. The total quantity for the six months of 1926 was 2,320,874 (\$2,160,411), as compared with 2,503,151 lbs. (\$2,320,844) for the same six months in 1925.

The five leading dyes imported during June were as follows:

	lbs.
Cross dye green B	19,446
Ciba scarlets (single strength)	13,365
Rhodamine 6 GDN extra (single strength)	10,715
Ciba red 3B (single strength)	8,212
Hydron printing black RD paste	7,500

Dyes and intermediates remaining in bonded customs warehouses were:

Date.	Dyes and Colours.	Intermediates.
	lbs.	lbs.
July 31, 1925	775,916	1,378,837
August 31, 1925	767,431	1,363,760
September 30, 1925	709,381	1,359,717
October 31, 1925	609,750	1,055,241
November 30, 1925	521,238	740,226
December 31, 1925	633,525	758,618
January 31, 1926	703,159	763,409
February 28, 1926	596,154	855,170
March 31, 1926	447,588	896,530
April 30, 1926	359,164	928,593
May 31, 1926	535,226	946,120

Germany is still the principal source of supply, although the percentage total for June fell 9½ per cent. below May and is on a parity with that of April—51½ per cent.

Per Cent. of Dyes by Country of Shipment.

Country.	June.	May.	April.	March.
Germany	51½	60	51½	48
Switzerland	36	28	38	34
France	1	1	2	3
England	7½	3	2	6
Belgium	3	5½	3½	4
Canada	0½	0½	1	2½
Italy	0½	1	2	2
Holland	—	1	—	0½

While there was a slump in import totals of some of the other groups, as indicated above, the inward movement of synthetic aromatic chemicals for last month was second for the half year, with a total of 16,591 lbs., valued at \$21,630, as compared with the highest month—March—when 19,752 lbs., valued at \$23,299, were brought in.

Imports of Synthetic Aromatic Chemicals.

	lbs.	Invoice.
January	8,690	\$11,165
February	15,568	19,235
March	19,752	23,299
April	15,436	20,824
May	12,114	13,963
June	16,591	21,630

Imports of Medicinals, Intermediates, Photographic Developers, and other Coal-tar Products.

January	211,832	\$50,342
February	103,273	42,900
March	122,655	58,004
April	87,854	47,730
May	139,625	44,518
June	146,662	74,396

Imports of Colour Lakes.

January	2,773	\$2,393
February	143	—
March	58	—
April	834	—
May	3,360	3,077
June	2,720	1,598

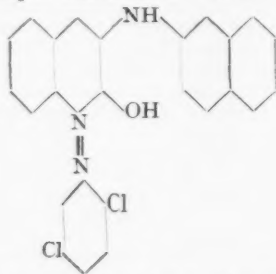
Dyes and their Application: Recent Technical Progress

By L. J. Hooley

Pigment Colours

GREEN and greenish-blue lakes are obtained by incorporating the dyestuffs formed by the action of ferric chloride on naphthalene-1,2-diamino-8-chlor-5-sulphonic acid, with the usual substrata such as barium sulphate. (M.L.B., B.P. 248,487, F.P. 590,464.)

Diazo compounds fast to vulcanisation and so specially suitable as body colours for indiarubber are obtained by coupling the β -naphthalide of β -oxy-naphthoic acid (Naphthol AS. SW.) with diazo compounds containing substituents, one at least of which is chlorine, in the 2 and 5 positions. The products are red to bluish-red in colour. (I.G.F.A., B.P. 250,909.)



Emulsions of dyestuffs for lake making may be prepared by treating a solution of the colour in a colloid mill along with substances such as oils, soaps, fats, starches, etc. The emulsions are then worked up with the usual grounds. (Goedecke, C.E.J. B.P. 245,678.)

Cellulose compositions or solutions may be coloured by rolling in the dyestuff, preferably in a colloidal condition, until a homogeneous product is obtained and until a diluted test portion is found to be sufficiently stable on standing. (B.A.S.F., B.P. 247,288.)

Many of the faster dyestuffs, particularly the vat colours, are, unless specially prepared, apt to have a dull appearance when in the solid state and to appear unsuitable for use as pigments. As a result they have not yet found anything like adequate use in paint, oil, and varnish colours. Very great improvements have taken place during post-war years in the conditions in which these colours are put out, both as regards state of division and purity. Impurities in the colour may not have an appreciable effect on shade in vat dyeing, as unless the impurities are also vat dyes they either do not go on to the cotton or are removed during soaping. For pigments, however, the dulling effect of impurities cannot be avoided. In order to incorporate the colour in media, it is necessary, except where true solution takes place, to begin with the colouring matter in as fine a state of division as possible, which with insoluble colours usually means in the form of aqueous pastes; and to substitute the necessary oil or varnish for the water without losing the fineness of division is the colour makers' principal problem. The obvious method of drying the paste and taking up again in the necessary vehicle is not, of course, of any value, if the drying is carried out in the ordinary way. In B.P. 240,852, M.L.B., the fine state of subdivision of the aqueous pastes is preserved while converting to the dry form by mixing the suspensions with a resin or fatty acid, then precipitating with acid, filtering, and drying. In an addition to this patent (B.P. 246,447), the dyestuff is used in the dry state by mixing with a resin or fatty acid, finely subdividing along with an oil or other softening agent by grinding, and then dissolving in a suitable cellulose varnish. An example is given with Hansa Yellow.

An important point in connection with the manufacture of pigment colours from vat dyes and other insoluble substances is that the colour does not require to be first fixed as a lake. In fact, with many of these the chemical structure does not offer any possibilities of lake formation. In the past, however, the custom of forming lakes, either before or concurrently with the mixture with the substrata has been so general that it is liable to be regarded as an indispensable part of the process.

Intermediates

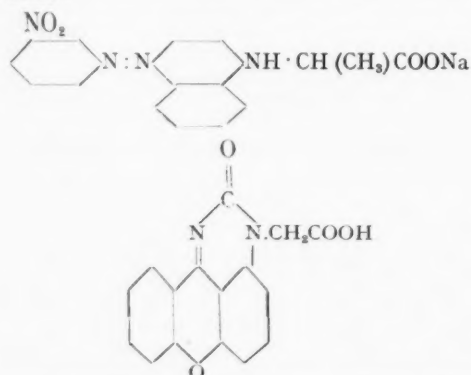
Substituted diphenylamine derivatives are obtained by condensing the alkali metal compounds of amines with halogen

benzene derivatives in the presence of copper as a catalyst. Thus *o-o*-ditolylamine is obtained from *o*-chlor toluene and *o*-toluidine at 250-300° in a closed vessel (S.C.I.B., B.P. 250,819). Nitro bodies may be reduced with simultaneous introduction of sulphonic acid groups by treatment with sodium hyposulphite along with an acid such as acetic. Thus from nitrobenzene, acetanilide and sulphanilic acid may be obtained, and from α -nitronaphthalene a mixture of amino naphthalene sulphonic acids and acetamino naphthalene.

Professor A. G. Green has described a method for controlling the catalyst temperature in the catalytic oxidation of hydrocarbons, particularly the production of phthalic anhydride from naphthalene by oxidation in the presence of vanadium pentoxide. As this is carried out at 400° C. or over in the presence of excess of air, the oxidation easily gets out of hand, as the reaction is strongly exothermic and is accelerated by rise in temperature. The importance of keeping the temperature in the neighbourhood of the catalyst under proper control will, therefore, readily be seen. This is managed in this patent (B.P. 249,973) by arranging the catalyst on perforated trays and by spraying water between the trays by means of atomisers. This method has the advantage that the cooling agent is brought directly to the point at which it is required. The amount of steam introduced is stated to cause no inconvenience. Many syntheses with phthalic anhydride require aluminium chloride as a condensing agent. A recent American patent describes the production of this by the known method of passing chlorine over carbon and alumina, but an oxide of carbon is mixed with the gas until the reaction starts in order to shorten the period of induction. (U.S.P. 1,578,052. A. McD. McAfee. Assr. to the Gulf Refining Co.) Other patents on the production of this substance have been taken out by the same company, and in fact a considerable number of methods for the production of this substance have been described in recent years in America, where aluminium chloride is of special importance in connection with the refining and cracking of petroleum. In most of these the process is carried out in medium-sized vertical furnaces. The price of aluminium chloride is an important consideration in all condensations with phthalic anhydride, as one molecule of phthalic anhydride requires theoretically one molecule of aluminium chloride, reckoned as Al_2Cl_6 .

Acetyl Silk Dyeing

Two patents have been published recently by the British Alizarine Co. 252,240 (C. M. Barnard, B.A.C.) describes a variety of compounds containing carboxylic acid groups. As an example naphthyl alanine is prepared by treating α -aminonaphthalene with potassium cyanide and acetaldehyde, and the resulting product coupled with diazotised nitraniline. In another example anthrapyrimidone is treated in alkaline solution with chloracetic acid at the boil to give the product shown below.



The former dyes orange and the latter yellow. In 252,646 (C. M. Barnard, B.A.C.), derivatives of a somewhat similar type are described, e.g., amino mercapto derivatives are condensed with chloracetic acid, and the products, which may contain NH_2CH_2COOH or SCH_2COOH groups, are then used for dyeing acetyl silk.

Dyestuffs Markets: The Month's Business in Review

Lancashire

The market for dyestuffs has not experienced any serious depression during the month, from which it would appear evident that despite difficulties and increased costs dyestuff users are to a large extent carrying on their respective businesses.

The difficulties are, however, cumulative, and the dyestuff manufacturers are now feeling the effects of the coal stoppage not only in the shortage of coal as a fuel, but also in the shortage of benzene and toluene—the by-products of coal used in other industries and two of the most important raw materials in their industry. Prices for such materials are considerably higher, but it is anticipated that it will be possible to carry on if, as is confidently predicted, the coal strike should last until October.

The problem of setting in order the house of those interested in the manufacture of dyestuffs is being gradually resolved, and in this connection Lord Ashfield's speech, at the shareholders' meeting of the British Dyestuffs Corporation, throws some light on the policies now in progress of evolution. He stated as his opinion that this is the age of big businesses, that he does not believe in a policy of isolation, and that the chemical industry of this country could be most efficiently run as a unit. Certainly, it is the fact that many foreign dyestuff manufacturers, including some American firms, have large and profitable interests in the manufacture of products other than dyestuffs, and there can be no doubt that such concerns are very favourably placed in the intense competition which now exists in all unprotected markets.

Mr. Sutcliffe Smith, in his address to the Colour Users' Association, and speaking as a colour user, has apparently similar views, and in reviewing the consolidation and expansion of the German chemical industry he stated that "the lesson is consolidation of interest, research on wide lines, and production in big units." Bearing on the same point, it is reported from Germany that the I.G. has made a price agreement with the Swiss firms, and that further negotiations are taking place with a view to consolidating the position of continental manufacturers in the face of American competition. The latter, apparently, has reference to Eastern markets.

Yorkshire

A redeeming feature of the effect of the protracted coal stoppage on the intermediate and dyestuff industry continues to remain in evidence; it is the "die-hard" character of demand for its products. True, there is a gradual diminution, but prospects of "paralysis" of the trade, which in the early days of the stoppage was feared, are too remote to afford any real encouragement to labour of the "Red" persuasion. Fuel, consisting of coal, foreign, surface, a small quantity raised from pits and oil, is available, but the cost is high. One hears of warp dyers continuing to work full time mainly for export, Australia being a good customer for the dyed warps, and that shipments of textile goods from the Huddersfield district to Canada and South America at least equal expectations. For the home trade there is no lack of inquiry, and in some quarters quite a hopeful tone prevails. In the Dewsbury district textiles, a spurt experienced was accounted for by the need for deliveries before the feast holidays.

The Yorkshire branch of the new British company, I. G. Dyestuffs, Ltd., commenced operations on July 1 and is apparently settling down to its function of distributing in this country the dyestuffs and auxiliary products manufactured by the German I. G. Farbenindustrie. This has rendered it impossible for a number of firms who had previously carried on the business to import independently.

There are now signs, in the form of increasing prices, of growing shortage. Published quotations are largely nominal, actual prices being governed by available supplies and the attitude of the Dyestuffs Advisory Licensing Committee.

Aniline oil spot fetches 10s. delivered, aniline salt spot 10s. 10d., and nitrobenzene 7½d. Lack of benzene is at the root of the matter and this arises, of course, from the shutting down of the British coke ovens. It is anticipated that supplies from this source will not become available for at least five weeks after general resumption of work in the coal mines. Meanwhile, supplies from abroad are sought at 25 per cent. increase in price, and distillation is carried out

at a fuel cost increase of about 400 per cent. The price of pure xylene has also increased 25 per cent., and now stands at 4s. 3d. per gallon. Other products showing price advances are tar, creosote, and cresylic acid.

Reports to hand indicating a determination on the part of the Bradford Corporation to compete against its own rate-payers in the manufacture and sale of sulphuric acid give rise to alarm, not only among makers of this widely used dye bath assistant, but among traders generally. Hitherto it has been the policy of municipal corporations to confine their trading activities to the general welfare of the communities which they govern, but now we are faced with the prospect of a different policy striking at private enterprise and capable of extension so as to become a danger to the economical sources from which civic authority derives its financial strength.

Midlands

Dye consuming concerns in this area worked an average of three days per week during July. Most of the dyehouses were closed for at least the first week in August. Those dealing chiefly with woollen goods are particularly short of orders. Spinners say they can sell nothing at the moment; they are, however, on the whole optimistic, and most of them have made fairly extensive purchases of wool. At the last of the local annual wool sales, prices were appreciably harder than at the earlier sales, which goes to prove that spinners expect business as soon as the coal dispute is settled.

Manufacturers of woollen hosiery should now be busy with autumn and winter goods, but at present only very small hand-to-mouth orders are being obtained.

In artificial silk hosiery, trade is decidedly patchy. A few fairly good orders for cheap quality goods for export have been obtained, but the demand for the home trade is poor. Natural silk hose shows no improvement. Cotton hose is not selling. Sewing cotton is in small request. There are a few inquiries for fadeless lace curtains and a little trade has been done in fabrics for bathing costumes and fleeced knitted fabric for cheap underwear.

Tanners of heavy leathers are having a bad time. Coloured glacé kid is selling fairly well; the same remark applies to leathers for upholstery.

Prices for most dyestuffs are the same as a month ago; in a few cases reductions of about 5 per cent. have been made. Aniline oil and aniline salt are unchanged.

Scotland

The holidays may, perhaps, be regarded as the most important feature of the last month. The Glasgow ones began on July 19, lasting for a week or ten days, but the majority of the others were later. These have probably been more welcome this year than usual, both from the point of view of getting away from business and also as providing an easy way of getting through another week of the stoppage. The most surprising feature under the circumstances is that in so few cases has an extension been made on the usual holiday period—at any rate as far as Scotland is concerned. Of course, the incidence of the break has made a still further drop in orders, but this is unavoidable anyway. Considering that the stoppage is now into its fourth month, the general state of affairs is creditable as showing the determination to make the best of the volume of trade that is still left, and not to allow despair to turn bad into worse.

The woollen trade in the south of Scotland which has been affected more by shortage of fuel than by orders, is still in a fairly sound position, although there has been a gradual falling off during the last three weeks, but this probably marks the dividing line between the winter and spring seasons' orders. The hosiery sections, which have been more badly hit all through, have on the contrary shown an improvement, particularly in the silk using sections, for which the good weather and holidays may be largely responsible.

The dyers, although busy spasmodically, are no better off than last month. Dyestuff orders have been fairly sustained considering the loss of a week in the month.

The annual report of the British Dyestuffs Corporation has confirmed the closing of the Clayton and Turnbridge works, with the removal of the processes to Dalton and Blackley, or to the Scottish Dyes works at Grangemouth.

Around the Works : (7.)—J. C. Oxley's Dyes and Chemicals, Ltd.

THE activities of the firm of J. C. Oxley's Dyes and Chemicals, Ltd., form yet another example of the British gift of rising to the occasion. The company was founded in 1916 for the production of war materials: in the first instance pure benzol, toluol, and naphthalene were produced, and until the end of the war period dyes for khaki. With the cessation of hostilities broader activities in the manufacture of dyestuffs were pursued. A start was made with the production of Lighthouse Chrome Yellows, and the range of chrome mordanting colours has since been extended to oranges, browns and reds. The firm has also specialised in making light-fast acid wool dyes suitable for the Bradford dress goods trade. The first of this series put on to the works were Orange G and 2G, followed a little later by Brilliant Acid Rosamine 2G. The manufacture of the latter

colour is said to have had the effect of reducing the price of the commodity to one quarter of the rate at which it was then supplied from the Continent, and also to have compelled the foreigner to have this particular dye made in this country by British labour.

Amongst many other colours which are being produced are Hydroxine Yellow, Pyrazine Yellow, scarlets for wool, and Acid Blacks. The list includes acid colours, chrome colours, direct cotton colours, leather colours, union colours, and jute colours. The company has installed a dye laboratory for testing and matching samples and for standardising products, and it has a well-equipped and competently-staffed research laboratory. The company operates at Lighthouse Chemical Works, Dewsbury Moor, Dewsbury.



THE WORKS OF J. C. OXLEY'S DYES AND CHEMICALS, LTD., AT DEWSBURY.

The Dyestuffs "Who's Who"

6.—Mr. C. J. T. Cronshaw

ON its human side the history of the British dyestuff industry can furnish few more striking features than the career of Mr. Cecil John Turrell Cronshaw, who, becoming technical manager of the British Dyestuffs Corporation at the age of 36,

is now responsible to Dr. E. F. Armstrong, the managing director, for the management of the four works of this vast organisation, and of its entire research and engineering activities. A graduate of Victoria University, Mr. Cronshaw joined the Research Department of Levinstein, Ltd., in 1915. He quickly attracted the notice of Dr. Herbert Levinstein, who in 1916 commissioned him to take over the Ellesmere Port indigo works, formerly operated by Meister, Lucius, and Brüning, and to initiate the manufacturing process. Immense technical difficulties, inherent in the circumstances, and enhanced by every possible action on the part of the factory's previous occupants, were brilliantly overcome, and within a very few



MR. C. J. T. CRONSHAW

weeks synthetic indigo was being economically and efficiently produced.

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In the course of the following year Cronshaw was busily engaged in negotiating the exchange of technical information between Levinstein, Ltd., and the Du Pont Co., and made an extended stay in the latter's works in America. Following this experience he acted, after the armistice, as Chemical Controller in the British Rhineland area, and in this capacity obtained an extensive insight into the operations of the great German chemical factories. A little later, in 1919, came about the amalgamation of Levinstein, Ltd., with British Dyes and the formation of the present Corporation.

Dr. Levinstein, who had become technical managing director, selected Mr. Cronshaw as his chief administrative assistant, and in 1921 appointed him manager of the Blackley works of the Corporation, Manchester. Success in this and of previous undertakings was fitly marked by the award to him three years later of the chief technical appointment in the company, an appointment which has already, in less than two years, been abundantly justified by results. An undertaking such as the British Dyestuffs Corporation demands much more than chemical knowledge from its chief executive officers. Courage, resource, and patience are exacted as well as real qualities of leadership, all of which have been abundantly displayed. The Corporation is fortunate in having at its service in the present stage of its fortunes men of the calibre of Dr. E. F. Armstrong and Mr. Cronshaw, and, aided by the former's support and fundamental chemical insight, Cronshaw's services, in the past, considerable as they have been, should be greatly exceeded by those to be rendered in the future.

Swiss Dyestuffs

THE annual report of the Society of Chemical Industry in Basle shows a net profit for the year 1925 of 3,252,354 francs, as compared with 3,196,451 francs in 1924. A dividend of 15 per cent. has been declared upon the share capital of 20,000,000 francs.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

The Coal Outlook

THE condition of the dyestuffs industry is becoming more and more dependent on the coal situation, and although the prospects are brighter in the sense that the parties are feeling their way towards a basis for negotiation, no definite step towards a settlement is yet announced. The industry has carried on remarkably well in such adverse circumstances, but the loss and dislocation of trade are serious, and a settlement of the coal dispute is the one end for which everyone is now hoping. Not only are the prices of fuel very high and the quality in some cases not the most satisfactory, but both the supply and the prices of coal tar products, especially the indispensable intermediates, are causing considerable anxiety. One thing, however, is now certain. The worst part of the crisis is over, and a resumption of work in the coal fields is now only a matter of weeks.

Cheaper Vat Colours

COLOUR users will no doubt be gratified to learn that very considerable reductions have recently been made in the prices of vat colours by the British manufacturers, though the demand for yet cheaper dyes will probably not be silenced. The trade in cotton materials dyed with fast vat colours has shown considerable expansion of late, and the dyestuff makers are naturally looking to the trade to develop this tendency and thus, by increasing the demand and enabling the makers to produce in larger quantity, gradually to reduce production costs. There is no doubt that the demand for fast colours, even in the cheaper classes of goods, is extending in this country. The same tendency in America has recently been noted by Mr. Van Riper, of the du Pont Co., who ventures to predict that in five to ten years every piece of washable goods manufactured will be guaranteed absolutely fast. The sense and the love of colour has been enormously cultivated among all classes in recent years, and the feeling is growing that the public will not much longer be content with fugitive colours even in the cheapest materials. The raising of standards of quality in any industry is always to be welcomed.

Rumours !

OUR Lancashire correspondent, who is in close touch with events, makes significant allusion to two matters—the first the policy of the I.G. to enter the field of artificial silk production; the second the revival of rumours as to some working agreement between the I.G. and the British Dyestuffs Corporation. Some weeks ago we quoted the confident opinion of a writer in the *Chemiker-Zeitung* that some arrangement would before long be reached. These statements, it is suggested, may possibly explain the rumours that the recent buying of B.D.C. shares has been to some extent on German account.

Fall and Rise of the B.D.C.

UNDER this heading the following note appears in the current issue of the *American Dyestuff Reporter*:—"An outstanding example of the part that proper management can play in regaining the prestige and stability of an industrial corporation that has fallen to the level of a veritable financial and technical failure is the case of the British Dyestuffs Corporation. The history of the company's unsuccessful operation under the supervision of the British Government, its slow, uncertain progress in both manu-

facture and research, its recurrent internal disorders, resulting from a directorate inexperienced in managing such a highly technical enterprise, its enigmatic and futile attempts at amalgamation with the German dye trust and its final decline to a state of neutral influence in the dye industry of Great Britain, all present a distinct contrast to the upward course of the B.D.C. since its reorganisation last year as an independent concern. With a new directing board that includes some of the distinguished figures in British chemistry and with a controlling interest in Scottish Dyes, Ltd., it embarked with a hopeful spirit several months ago upon the difficult task of regaining its influence. It formulated a definite programme of management involving the concentration of its plant facilities and adequate research work, to assure greater production at minimum cost and a steady development of new colours. Evidently this has been successful. The period of suspicion and criticism seemingly ended with its reorganisation. The public's confidence in the future of the corporation is reflected in the encouraging report of the profits earned during the first half of its new existence and in the recent declaration of a dividend of 2½ per cent. Those who maintain that profitable dyestuff manufacture demands a skilful combination of technical and commercial brains can point to this case as one more instance of the successful application of their theory."

Lissamine Green SF.

THE latest addition to the B.D.C. range of acid colours is Lissamine Green SF, which is described as giving level shades of outstanding brilliance. It is suitable for application to all types of woollen materials where brilliance of shade is of prime importance, but particularly for the production of bright greens on dark coloured woollen materials. One of its advantages is that it leaves cotton, viscose, and cellulose-acetate silk effect threads unstained. It is also of use in the dyeing of silk and tin-weighted silk. Lissamine Green SF is dyed in the method usual with acid colours, with Glauber's salt and sulphuric acid.

Other New Colours

THREE new direct colours have been issued by the National Aniline and Chemical Co., Inc., of America. Two of them are additions to the Solantine series, and are light-fast. National Solantine Yellow 4 GL produces a pure greenish yellow shade, finding its greatest application on cotton, rayon, and pure and tin-weighted silks, although it possesses strong affinity for wool; it is useful in the printing trade. National Solantine Orange G is said to yield pure orange shades fast to washing, perspiration, rubbing, hot pressing, etc. National Erie Garnet RB is said to be useful for half-wool and in textile printing. The Newport Chemical Works, Inc., of America, have placed two new colours on the market. Thianthrene Brilliant Red 3 B Paste gives a brilliant bluish shade fast to light, chlorine, steaming, etc., and is of use in printing cotton, rayon, or pure silk. Thianthrene Orange R Paste gives a clear bright shade, and is said to be characterised by ease of reduction and good levelling and penetrating properties. It is fast to light, boiling soap, rubbing, steaming, etc., and gives good printed patterns on cotton, rayon, and pure silk. Three new Indigosol colours, Indigosol Scarlet HB, Indigosol Red HB, and Indigosol AZG, are described in a folder issued by the Carbic Colour and Chemical Co., of America. They are

chiefly useful for calico printing, and are best developed by the steaming process. Direct Fast Brown 5 R is the latest addition to the products of the Peerless Colour Co., of Plainfield, N.J. It is a level dyeing, reddish-brown colour, and may be used on cotton, half-wool, half-silk, leather and rayon. It may be diazotised and developed on the fibre with naphthol, resorcinol, etc., producing various brown shades. The E. I. du Pont de Nemours Co. have placed two new colours on the market. Du Pont Chromate Brown EB, chemically similar to Anthracene Chromate Brown EB, may be used for dyeing woollen yarns. It is light-fast, and is best dyed by the chromate method. Sulfogene Fast Green B is of a bright bluish tone, which is said to change very little on after-treatment. It is fast to light, acids, alkalis, and cross-dyeing. The Newport Chemical Works, Inc., of America, has issued a leaflet describing its new product, Newport Anthraquinone Blue Black R, for wool. It is fast to light, fulling, steaming, etc.

Darker Shades

MR. GEORGE HEYWOOD, chairman of the United Indigo and Chemical Co.—reviewing in a hopeful tone a balance sheet for the year which showed a trading profit of £17,111 against £21,440 for the previous year—remarked that a year ago light shades of colour were very much in demand, and that this condition still existed. They heard now that before long there might be a change to heavier and darker shades, which would be helpful. If such were the case, there were signs, he predicted, of a considerable all-round improvement in trade in which they hoped to share.

Dye Cost in Fabrics

THE question of the dye price in proportion to the total cost of the finished fabric has frequently been heard of late—one party contending that the competition in textiles is so keen that a higher or lower price for dyes may be the deciding factor; the other being equally confident that the proportion of the dye cost to the total cost of production is so small that it is almost negligible either way. The United States Tariff Commission has decided to have this point definitely settled. The investigation it undertook some months ago into the cost of dyes in specific fabrics and garments is nearly completed, and the report is expected to be issued this month as part of the Annual Census of Dyes and other Coal-Tar Products.

The data compiled by the commission in an effort to arrive at the average cost of dyes in various kinds of fabrics and wearing apparel were obtained only after considerable research among dye manufacturers and importers, textile manufacturers, producers of men's and women's apparel, and dyers and finishers. The information gathered from these sources was analysed and supplemented by replies to a questionnaire sent to a number of business men. It will be the first comprehensive study ever undertaken by a government agency for the purpose of determining, on the basis of the retail unit of piece goods and garments, the cost of the dyes used in fabrics. The work of the commission has been carried out under the direction of Dr. W. N. Watson, colour specialist of the Chemical Division, who also has charge of the census of dye manufactures, which has become an annual feature of the commission's work and is regarded by the industry as of the greatest value. The study of dyes in textiles, when completed, will present a summary giving average cost of dyes as they appear in a suit or overcoat or in a dress or wrap and in a yard of piece goods, together with statistics giving the maximum and minimum range of costs with the use of dyes of different qualities producing the same approximate shade. It embraces studies of identical dyes in materials of different fibres and different construction. Altogether, it is said that this study will present facts of deep significance to the textile and dye industries not hitherto disclosed in any statistical study.

Dr. Armstrong's Outlook

IN his recent review of the problems and prospects of the organic dyestuffs industry, Dr. E. F. Armstrong, out of the fullness of his knowledge, sketches lightly and yet firmly the main features, stating in terms to be easily followed by the layman what to chemists and other students of the dyestuffs situation is now fairly familiar matter. But all through his article those who know him will recognise the essentially scientific mind behind the commercial worldly wisdom—the believer in fundamental research as the key to all real progress. No word, perhaps, he rightly says, is more misunderstood or misused than "Research"; in his view the term should be ennobled and kept for the study of something really new and fundamental. "With this definition in mind," he writes, "one can confidently state that never was research more active in the organic chemical industry, both in this country and abroad. 'New routes to old chemicals' is the cry, routes which, in many cases, will enable the product in the near future to be quoted in hundredweights, if not in tons, instead of in pounds as in the past. Armed with cheap synthetic products, industry will be able to make all sorts of materials available for the public in novel and improved forms. Illustrations are afforded by the progress in the rubber industry, and by the artificial paints, varnishes, and leathers which every motorist appreciates and which cumulatively are going to make the small car of the future come very close to £100 in cost. If, at the same time, the anticipated progress in synthetic motor fuels is realised, the term 'motorist' will become synonymous with 'man in the street,' and both will have reason to be interested in the progress of the synthetic organic chemical industry. Nor is the woman being neglected—raiment of every hue, dyed no longer in one colour only, fabrics of great charm and delicacy built up from wood itself, instead of being spun by the silkworm—and as yet we are only on the threshold of discoveries in this direction—await her choice and testify to the chemist's interest in her well-being. Internal decoration may in a few years take on an altogether new phase when the new paints and new leathers and rubber materials are available."

In short, Dr. Armstrong's view is that a new Aladdin's lamp is in the hands of the chemist. "Britain must not be allowed to stand aside in these developments, but if she is to take part in them her manufacturers must be enabled, nay encouraged, to develop the organic chemical industry. The prizes for success appear so great that far-sighted competitors would be willing to take any steps to crush this new British industry in its infancy, and we must be alert both individually and collectively, and also through our Government departments, to counter such moves and be ready to watch over the infant industry, and perhaps nurse it, through its infantile complaints, its school days, and even the period of adolescence."

How the News Goes Round

ABOUT the middle of June we published a special review of the activities of the I.G. Farbenindustrie, with special reference to the dyestuffs industry, based upon current articles in the *Chemiker-Zeitung*. In due course, as is usual, our notices were reproduced in several of the American journals, one of which made extended literal quotations from THE CHEMICAL AGE articles. Under the heading "An American View," an English journal which gives attention to dyeing and calico printing reproduces in its September issue, from the New York publication, exactly the information we published in THE CHEMICAL AGE of June 19. Thus are our humble efforts to disseminate knowledge in both hemispheres rewarded and thus does the home reader find his news returned to him, like bread upon the waters, after many days—in this case nearly three months.

Perylene and its Derivatives

As perylene is the parent substance of a large number of vat dyestuffs which are becoming more numerous almost every month, this summary of the chemistry of perylene and its derivatives is of particular interest.

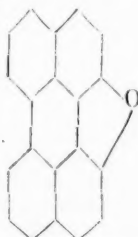
PERYLENE was first described by Scholl, Seer, and Weitzenback, who obtained it in small yield by heating 1:1' dinaphthyl with anhydrous aluminium chloride at 140-145°. Its constitution was established as being a peri derivative by also



making it from 1:8 di-iodo naphthalene and-copper powder.

Perylene is obtained in the form of yellow crystalline plates, M.P. 264-5°. It dissolves in the higher boiling organic solvents, giving yellow solutions with a brilliant blue fluorescence.

Attempts were then made to improve the yield of perylene and its derivatives by choosing suitable materials for the condensation. β Naphthylene oxide was heated with aluminium chloride; alkaline extraction of the mass resulted in the isolation of 1 hydroxy perylene, M.P. 197°; from the portion insoluble in alkali, 1:12 furo-perylene was isolated. (Ber. 1913, 46, 1994).



Later, a satisfactory yield of a perylene derivative was obtained by condensing 4:4' dicyano 1:1' dinaphthyl, with the formation of 3:10 dicyano perylene M.P. 368-9°, which can be converted into the corresponding dicarboxylic acid by the action of alcoholic soda under pressure. (Ann. 1913, 398, 82.)

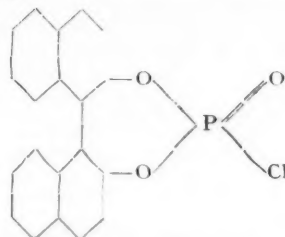
A process was patented for the preparation of 1:12 dihydroxy perylene by heating 2:2' dimethoxy 1:1' dinaphthyl (or other alkyl derivative) with four times its weight of aluminium chloride in the absence of moisture for two hours at 140-150°. The mass is treated with hydrochloric acid, and the dihydroxy perylene formed is separated and purified by precipitation from caustic soda or glacial acetic acid solution; it is easily soluble in the latter solvent, as well as in benzene or toluene, but sparingly so in alcohol. (E.P. 165,771.) By heating one part of the dihydroxy derivative with two parts of zinc dust in an atmosphere of hydrogen, perylene is formed. (E.P. 165,770.)

Methods of Preparation

The best method for the preparation of perylene, however, appears to be from β dinaphthol (2:2' dihydroxy 1:1' dinaphthyl). One patent describes the preparation of perylene from this body by heating it with a metallic salt, such as zinc, ferrous or ferric chloride. (E.P. 208,721.) Another process consists in heating β dinaphthol with halogenising agents, such as the halogen compounds of phosphorus, antimony, arsenic and others. It is stated to be advantageous to use a reducing flux such as phosphorous acid. When β dinaphthol is mixed with an equal weight of phosphorous acid, heated quickly to 500°, while an equal weight of phosphorus trichloride is added, phosphoretted hydrogen is evolved, and on fractionally distilling the residue, perylene is obtained, together with a small quantity of dinaphthyl oxide. The yield is 60 per cent. of the weight of the starting material, and 80 per cent. of this can be obtained in the pure state by recrystallisation from benzene or glacial acetic acid. If the starting material is

β β' dichloro α α' dinaphthyl the yield of crude perylene is 75 per cent. (U.S.P. 1,384,615.)

A somewhat similar process is the following: Phosphorus oxychloride reacts on β dinaphthol at 200° with the formation of this compound:



When two parts of this are distilled with one part of zinc chloride and half a part of zinc dust, a very good yield of pure perylene is said to be obtained. (E.P. 226,492.)

The best method of obtaining 1:12 dihydroxy perylene, from which perylene may be obtained, is that described in a recent German patent application. (D.R.P. Appl. T. 28,657.) The lead or aluminium salt of β dinaphthol is first prepared by double decomposition of the sodium salt and a salt of the appropriate metal. The dried lead salt when heated with aluminium chloride gives 86 per cent. yield of 1:12 dihydroxy perylene, while the aluminium salt, similarly treated in the presence of nitro benzene, gives 92 per cent. yield of the same product. Very similar is the process by which the same product is claimed with a good yield by heating β dinaphthol with aluminium chloride and a basic substance, such as the oxide, hydroxide or carbonate of the alkalis or alkaline earths. (E.P. 191,363.)

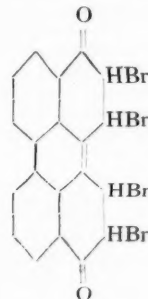
The Chemistry of Perylene

The chemistry of perylene and its derivatives has been worked out fairly completely, principally by Zinke and his co-workers. Perylene can be reduced by hydriodic acid and red phosphorus at 200-210°, giving hexahydro perylene M.P. 183°. Nitration with nitric acid (D 1'10) gives trinitro perylene M.P. 365°; when boiled with stronger acid (D 1'4), the tetra nitro compound is obtained M.P. 300°. (Monats, 1919, 40, 405.) It is easily oxidised to perylene quinone by boiling with aqueous chromic acid.

1:12 Perylene quinone is best obtained by heating 1:12 dihydroxy perylene with lead peroxide in benzene. It gives a light yellow vat, in which cotton is dyed a brilliant lemon yellow. (Monats, 1925, 45, 231.) Perylene quinone stands, as regards its quinonoid properties, between α naphthaquinone and anthraquinone. Its solution in acetic acid gradually deposits needles of perylene quinhydrone. Perylene quinol is obtained from it by reduction either with potassium iodide and phosphorus in acetic acid solution, or zinc dust and acetic acid. (Monats, 1924, 44, 339.)

Perylene quinone is readily nitrated; boiling glacial acetic acid and nitric acid (D 1'4) gives the dinitro compound. (E.P. 199,720.)

The action of bromine on perylene quinone in the cold is remarkable. It gives 1:2:11:12 tetra bromo tetra hydro perylene quinone;



this easily loses hydrobromic acid giving dibromo perylene quinone. (Monats, 1924, 44, 365.) The formation of the corresponding chloro compound, forming a greenish yellow vat dye, has been described. (U.S.P. 1,569,111.)

The mononitro, dinitro, or bromodinitro perylene quinones are all reducible by means of alkaline sodium hydrosulphite, giving amino derivatives, which are capable of acting as vat dyes, dyeing cotton brown to violet shades. (E.P. 199,720.)

Benzoyl groups may be attached to the perylene nucleus by the usual Friedel and Crafts method. Thus tetra benzoyl perylene is obtained by boiling one part of perylene, two parts of benzoyl chloride and one of aluminium chloride for six hours in carbon disulphide solution. The solvent is distilled off and the aluminium compound decomposed with hydrochloric acid. Tetra benzoyl perylene, M.P. about 320°, is obtained in good yield. (F.P. 591,271.) Some of the benzoyl derivatives of perylene have been described as the starting materials for vat dyestuffs; for example, 3:9 dibenzoyl perylene is converted by heating with aluminium chloride at 180° into isoviolanthrone (Indanthrene Violet R.) (Ber. 1925, 58, 323.)

Preparation of Vat Colours

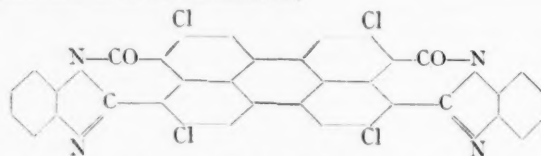
Perylene tetracarboxylic acid and its imides can be used for the preparation of vat colours. When the imide of naphthalic acid (naphthalene 1:8 dicarboxylic acid) is fused with alkali, the diimide of perylene tetracarboxylic acid is formed. (E.P. 26,690 of 1913.) If this is heated to a temperature of 200° with strong sulphuric acid, and the product poured into ice, brownish red needles of perylene tetracarboxylic anhydride separate. Perylene can be obtained from this body by the dry distillation of the calcium salt. On being heated with amines the acid gives vat dyes. (D.R.P. 394,794.) This latter reaction has been extended in a further patent (E.P. 201,786); the acid on being heated in a closed vessel with ammonium carbonate at 200° to 230° gives a bordeaux red vat dye; methylamine hydrochloride at 180° to 190° gives a red violet dye, and aniline at 100° to 120° gives a blue red.

The mono-imide of the tetracarboxylic acid heated with primary amines gives vat dyestuffs; aniline gives a violet, *p*-chloro aniline gives a blue red. (D.R.P. 415,711.) The diimide can be condensed with formaldehyde in solution in strong sulphuric acid at 50°. The product then contains a $-\text{CH}_2\text{OH}$ group and can be condensed with various aromatic derivatives, such as *o*-chloro toluene (red vat dye), toluene (pink), etc. (D.R.P. 414,025.) The diimide may also be benzoylated, giving vat colours. Benzoyl chloride gives a blue red vat colour, *o*-chloro benzoyl chloride bluer red, *p*-chloro benzoyl chloride pink. (D.R.P. 411,594.)

Perylene tetracarboxylic anhydride can be condensed with substances having a reactive methylene group—e.g., oxindol, which gives a violet blue dye, quinaldine and 2:4 dimethyl quinoline, which gives a yellowish bordeaux colour. (D.R.P. 413,942.)

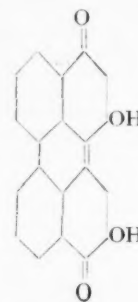
Dichloro perylene tetracarboxylic acid diimide can be con-

verted by the action of phenol in the presence of alkali into a chlorine free blue violet vat dye which is particularly fast to chloride. *p*-Toluidine similarly gives a bordeaux red shade. When perylene tetracarboxylic acid is condensed with *o*-phenylene diamine and the product chlorinated, a blue violet vat dye is formed of the constitution,



By treating this with phenol and caustic soda, it is converted into a blue vat dye fast to chlorine and washing. (D.R.P. 412,122.)

Either 1:1' dinaphthyl 3:4:3':4' diquinone or 3:3':4:4' tetrahydroxy dinaphthyl gives on treatment with aluminium chloride at 130° to 150° 2:11 dihydroxy perylene quinone, which dyes cotton blue black shades from a vat (D.R.P. 412,120.)



Various halogenated and nitrated derivatives of perylene can be condensed with aromatic acids and their acid chlorides in the presence of aluminium chloride (F.P. 589,643.) Some examples quoted are the following.

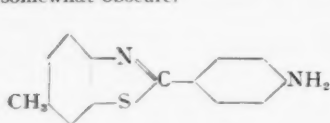
Dibromo perylene + Benzoic acid	Red violet
Bromo perylene + Benzoyl chloride	Blue
Dibromo perylene + Benzoyl chloride	Blue
Dibromo perylene + Salicylic acid	Brown red
Dibromo perylene + Phthalic acid	Brown violet
Dibromo perylene + Naphthoyl chloride	Red violet
Dinitro perylene + Benzoic acid	Brown
Dinitro perylene + Salicylic acid	Greenish brown

The above summary does not aim at being a complete account of the work that has been done on perylene and its derivatives, but serves to show how considerable a field may be opened up in general chemistry, and dyestuffs chemistry in particular, by the discovery and study of a new product.

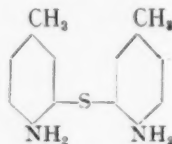
Basic Intermediates for Dyestuffs: II.—Dehydrothiitoluidine and its Analogues

By "Consultant"

DEHYDROTHIOTOLUIDINE was obtained by Green, one of the pioneers of the dyestuffs industry, in his preparation of the first of a series of colours known as the "Primulines," and is a sulphur compound (5) obtained by heating together paratoluidine and sulphur. The constitution of dehydrothiitoluidine reveals it to be a thiazole derivative, and it is very probable that thiitoluidine (6) is the intermediate formed between the raw material and the final product, although the mechanism of the formation of dehydrothiitoluidine is still somewhat obscure.



(5)

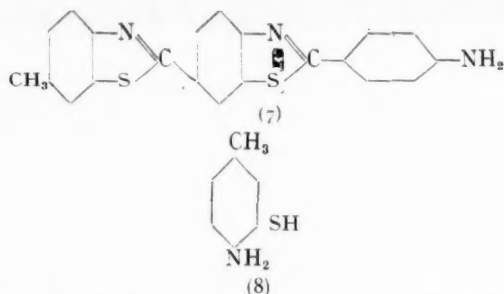


(6)

Pure dehydrothiitoluidine is very difficult to obtain, and in the method described above, which is the one usually employed for the large scale production of this intermediate, several other compounds are formed, which fractional crystallisation from various solvents is totally inadequate to separate from the dehydrobase. Among these impurities those preponderating are dehydrodithiitoluidine (7) and dehydrotrithiitoluidine, together with a certain amount of aminothiocresol and thio-*p*-toluidine.

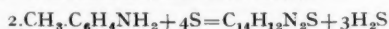
The best method of obtaining the pure substance from the commercial article has hitherto been by distillation, in vacuum at 2-3 mm. pressure, in a specially designed still. Pure specimens have, however, been more recently obtained by the method of Hunter, which involves the fractional crystallisation of the acetyl derivatives, which are more easily dealt with than the parent substances.

Pure dehydrothiitoluidine is a pale yellow crystalline solid, almost totally insoluble in water, but to some extent soluble in



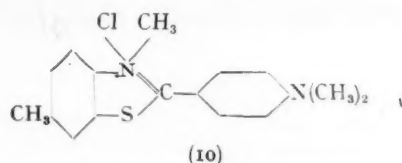
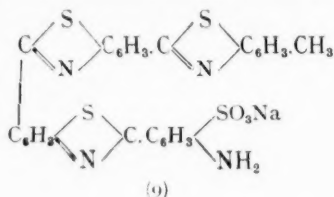
organic solvents giving solutions which have a most beautiful blue-violet fluorescence. Its melting point has been given variously as 191, 192 and 195° C. Extreme precautions must be taken in handling the crude dehydrothiitoluidine, especially the raw melt, as substances are present which rapidly set up an eczematous irritation of the skin. The problem as to whether this phenomenon is due to the pure substance or to the impurities with which the commercial article is always contaminated has not yet been settled.

Commercially, much of the dehydrothiitoluidine manufactured is utilised in the manufacture of colours of the Primuline class, for in spite of the fact that the parent substance of this group, Primuline Yellow, is somewhat fugitive, many of its developed derivatives and compounds are quite fast to light. In practice, *p*-toluidine (4 cwt.) and ground sulphur (1½ cwt.) are heated together in a stout iron pot fitted with an air condenser and a train of small absorption towers to remove hydrogen sulphide produced in the reaction. The vessel is also capable of being used as a vacuum distillation still later on in the process. The procedure is as follows. The contents of the pot are gradually heated until a temperature of 170–180° C. is reached when the reaction:—

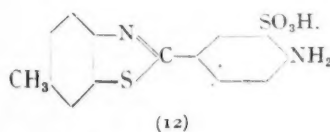
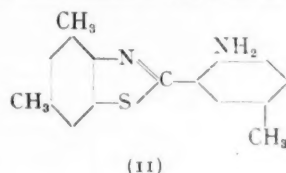


commences and is accompanied by the violent liberation of hydrogen sulphide. Heating is maintained at such a rate that the reaction is prevented from becoming violent and out of control and when the evolution of gas ceases (about two days) vacuum is applied and the excess of *p*-toluidine distilled off. This excess of amine is always used in practice, since it ensures that the temperature does not rise too high for the purposes of the preparation. In one Patent (G.P. 53,938) the addition of naphthalene is recommended for this purpose, but there seems to be no further advantage gained by its addition. When the excess of amine or naphthalene has been removed by vacuum distillation, the residual crude melt is run out into iron trays, and ground when solid. The average product obtained in this way contains approximately 52–55 per cent. of dehydrothiitoluidine, the remainder being Primuline bases. A certain measure of purification may be obtained by extraction with various solvents, but vacuum distillation is essential to proper purification. Such distillation is attended by considerable mechanical difficulties since the boiling point of dehydrothiitoluidine is very high, even under the best vacuum, and trouble is experienced with the clogging of the tubes. In one type of still used for dehydrothiitoluidine purification on the Continent the head-tube and receiver tube are electrically heated to such a point that although condensation takes place accumulation of the solid distillate is impossible.

Dehydrothiitoluidine was formerly much used for the preparation of Primuline Yellow (9) which was obtained by the sulphonation of the base, but the demand for this colour is not nearly so strong as formerly on account of its fugitive nature. By developing through diazotisation and coupling, mainly with α -naphtholsulphonic acid and intermediates of that class, some interesting shades of orange and red can be obtained.



A yellow which has been used various times is Thioflavine T (10) obtained by partial methylation of dehydrothiitoluidine. The xylylene analogue of dehydrothiitoluidine is known and its use in the preparation of dyestuffs has been covered by patent. It is prepared from *m*-xylylidine, but no great demand for dehydrothioxylylidine exists. Dehydrothiitoluidine, however, gives rise to a very important intermediate in the shape of its sulphonic acid, which is prepared and used in large



quantities. For the preparation of this intermediate no necessity exists for the use of a pure dehydrothiitoluidine, since the sulphonic acid can be comparatively easily separated from the accompanying acids, through the insoluble nature of its ammonium salt. The crude dehydrothiitoluidine melt (4 cwt.) is mixed with 100 per cent. sulphuric acid (10 cwt.), no special precautions being taken with regard to the temperature, which usually rises to 90–100° C. The mixture is cooled to from 35–40° C. and oleum (8 cwt.) is added at such a rate that the temperature does not rise above 40° C. throughout the addition, which takes practically one working day. Vigorous stirring is, of course, maintained throughout the whole addition and is continued after the final addition of acid until the sulphonation is complete. It is highly important to stop the process immediately the sulphonation is complete, and this is ensured by withdrawing samples from time to time and boiling with dilute ammonia. If unchanged dehydrothiitoluidine remains undissolved stirring is continued, but as soon as a sample is taken that gives a clear solution on boiling with dilute ammonia, the whole charge is poured into water (about 16 tons), when a yellow precipitate of mixed acids is obtained. This is allowed to stand, and the solid material filtered off and purified. The crude cake consists of the dehydrothiitoluidine sulphonic acid and primuline base, and is washed until the washings are acid-free, and then stirred with a slight excess of strong ammonia. At first the whole goes into solution, but the dehydrothiitoluidine sulphonic acid rapidly commences to separate in the crystalline state and after two days is filtered off comparatively pure. Primuline is salted out of the mother liquor. A ton of *p*-toluidine gives about half-a-ton of the sulphonic acid, and about 1½ tons of primuline, so that the preparation of dehydrothiitoluidine sulphonic acid is scarcely profitable unless some outlet for the Primuline can be secured. A German Patent (281,048) claims to obtain a different sulphonic acid which gives brighter and faster shades when converted into dyes. This is obtained by heating dehydrothiitoluidine with ⅔ of its weight of 100 per cent. sulphuric acid to 235–250° C. in vacuo, until no further water distils off. The residue is worked up in a manner similar to that described above.

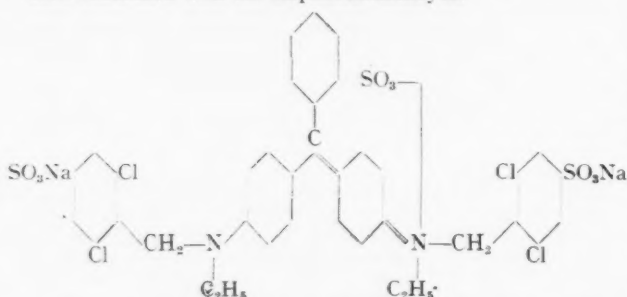
Dehydrothiitoluidine sulphonic acid is used mainly for the preparation of red and yellow dyestuffs. Oxidised with sodium hypochlorite it yields a very fast yellow, and it can be diazotised and coupled up to give a series of azo dyes, an example of which, although of a somewhat fugitive nature, is Thiazole Yellow obtained by coupling diazotised dehydrothiitoluidine sulphonic acid with dehydrothiitoluidine.

Dyes and their Application : Recent Technical Progress

By L. J. Hooley

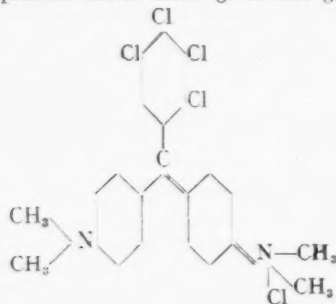
Triphenylmethane Dyes

THE triphenylmethane dyes have, of course, now lost much of their one-time importance, and as far as research is concerned they receive scant attention compared with the years following the discovery of magenta. In spite of their great beauty, they are as a class too fugitive for the present-day tendency in research. The additions of recent years are chiefly new modifications of known types without any outstanding new features. The latest patents are, however, well representative of the general methods of synthesis in this series and include basic acid and chrome colours. For example, in B.P. 250,785, Griesheim, acid colours are synthesised by the well-known method of condensing benzaldehyde with two molecules of an amine and then oxidising. The presence of sulphonic acid groups is arranged by using the ortho sulphonic acid of benzaldehyde and also sulphonated amines, the latter being alkyl benzyl arylamines containing halogen atoms in the benzyl nucleus. As an example 2,6-dichlor benzylchloride is condensed with monoethyl aniline, the product being sulphonated and the resulting sulphonic acid then condensed with the sulphobenzaldehyde.



They give greenish blue shades which are fast to alkali. They are closely allied to the Disulphine Blue A type.

In B.P. 251,511, Griesheim, basic dyes are obtained by the same method using chlorinated benzaldehydes without sulpho groups, and these have good affinity for acetyl silk, but have otherwise no special feature except the presence of three or four chlorine atoms in the one benzene nucleus. Simpler amines are used than in the patent previously cited. As an example the product shown below gives blue green shades.



The preparation of the necessary chlor benzaldehydes is given.

Chrome colours are given in U.S.P. 1,582,909 (Duisberg, Hentrich and Schepps), starting from *o*-cresotinic acid. This is condensed with *p*-chlor-benzaldehyde, and then further condensed with 6-chlor-2-toluidine. The products dye bluish-red on wool which is converted to reddish violet on chroming.

Fairly complicated dyes are obtained from substituted ethylene diamines by the well-known method with Mischler's ketone using phosphorus oxychloride as condensing agent. In the parent patent, B.P. 249,160, I.G.F.A., dialkyl diphenyl derivatives of ethylene diamine are used, while in the modified patent, B.P. 250,265, dinaphthyl derivatives of the ethylene diamines are employed. Either one or two molecules of the ketone may be used with one of the diamine. The products give violet to blue-violet shades on tannin or can be converted to acid dyes in the usual way.

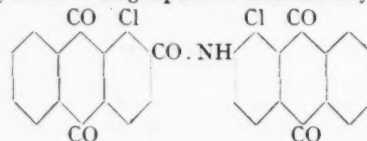
Acylaminoanthraquinones

A recent paper in the Monatshefte, 1926, 131, A. Rollett, describes the preparation of anthraquinonyl amino anthraquinones of the general formula A/q-CO.NH.A/q where A/q represents a molecule of anthraquinone. A few of these have been described before, but they have not appeared on the market. They are, of course, analogous to the benzoyl-amino anthraquinones first introduced by the Bayer Co. in 1909 and which have been of the greatest importance since. In the above paper anthraquinone carboxylic acids are converted to the acid chlorides with thionyl chloride and then condensed with amino anthraquinones.

The product from anthraquinone-2-amino-1-chlor and from anthraquinone-2-carboxylic acid-1-chlor, which is a yellow colour, is shown. These bodies are similar in properties to the simpler benzoylamino derivatives which have the advantage of requiring only the more readily available benzoyl chloride for their preparation.

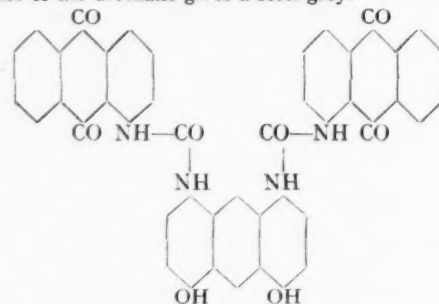
In D.R.P. Appln. B.115,489, I.G.F.A., a different type of acylamino anthraquinone is described, namely, the naphthoyl-amino compounds. α -naphthoyl amino groups are practically identical with benzoyl amino, but the β -naphthoyl derivatives give fuller shades. A/q-1.5-di- β -naphthoylamino can be dyed from a hot vat and is orange. The acylamino anthraquinones are in general dyed from a cold vat, i.e., at room temperature or up to 30-40°C., as they are liable to be slightly hydrolysed at higher temperatures, and, apart from this, dye better cold.

Among the benzoyl amino anthraquinones, there are to be included also the corresponding compounds of the dianthrimides and trianthrimides. For the production of these, intermediates such as A/q-1-amino-5-benzoylamino are often used. In B.P. 255,630, B.D.C., W. H. Perkin, H. M. Bunbury, this is prepared from the diamino body by carrying out the benzoylation with benzoic anhydride, a product free from the dibenzoylamino derivative being obtained, the small quantity of this body formed being separated automatically.



The oxalylamino body is prepared in a somewhat similar way from the 1.5-diamino by heating with oxalic acid to about 105-110°C. This substance does not give the amino body on hydrolysis or it could be used very conveniently for the synthesis of amino dianthrimides.

Analogous to the arylamino anthraquinones are the anthraquinonyl ureas. These bodies have been used as vat dyestuffs in the orange and yellow shades of the Helindone series. New examples of anthraquinonyl ureas containing hydroxy and amino derivatives as additional substituents in the anthraquinone nucleus have been recently patented, B.P. 248,858, B.D.C., W. H. Perkin and C. Hollins. In this instance, however, they are used not as vat dyestuffs but to give secondary shades on acetyl silk. The product from diamino anthrarufin and α -anthraquinonyl urethane gives a brown shade, while the condensation product of one molecule of chryazin with 2 molecules of the urethane gives a steel grey.



Dyestuffs Markets: The Month's Business in Review

Lancashire

There has been a decided drop in the volume of business during August, but as the latter is the holiday month in the Manchester district and normally is a poor month, the effect of the coal stoppage can be discounted to some extent. There is no doubt, however, that both consumers and manufacturers of dyestuffs are seriously feeling its effects in higher costs, delays in deliveries, and decreased business.

Considerable space is being devoted in the German papers to the activities of the I.G., much of it probably propaganda in connection with the scheme for the issue of a further 450,000,000 shares. Two items are of possible interest to dyestuff consumers. It is confidently suggested that the Courtauld-Glanzstoff new works at Cologne will lead to an understanding of the two firms with the I.G. which will result in a very much greater participation by Germany in the world's artificial silk industry. It is also confidently predicted that a working agreement with the British Dyestuffs Corporation will soon come into effect. The latter may explain the report in the British financial papers that the recent buying of British Dyestuffs Corporation shares was on German account.

It is very gratifying to learn that a very considerable reduction in the price of vat colours generally has been made by the British manufacturers.

The trade in cotton material dyed with the fast vat colours is one which has shown steady expansion despite the general depression. It would appear capable of much greater expansion with intelligent nursing. The vat colour manufacturers have made a very considerable contribution, and it is to be hoped that the dyers and finishers will pass on to the merchant the whole of it.

Yorkshire

Holidays in August are always expected to depress turnover in the dyestuff trade for that month. A falling off as compared with the trade in July is generally regarded as normal, but this year the decline is so marked as to compel one to realise that the prolongation of the coal stoppage is having an increased effect on industry. Cloth manufacturers in the heavy woollen district should now be busy for the winter trade, and indeed there is some improvement in the blanket department; some firms are on full time and substantial deliveries are being made. Manufacturers of colour lakes for paint-making report a maintenance of brisk demand for their wares.

When the stoppage began many of the dyers held large stocks of British coal, but most are now using foreign or outcrop coal or burning oil, executing orders at a loss, and exhibiting great fortitude towards their difficulties. It is estimated that 90 per cent. is foreign coal, 8 per cent. outcrop, and 2 per cent. from English mines.

Shortage of benzene continues a source of difficulty to the intermediate maker, and, consequently, to the maker of dyes. Supplies are almost exclusively foreign and prices still stand high. Pure xylene is spoken of as being unavailable, and pure toluene is becoming scarce. Aniline oil and salt stand much in the same position as last month, the former being quoted, when available, at 9½d. per lb. delivered, and nitrobenzene at 7d.

Although the prices of intermediates have increased it cannot be said that the makers are having other than a thin time. The increases do not fully cover the increased cost of production. Dyestuff and lake makers do not appear to have advanced their prices, and jointly with the intermediate maker continue to shoulder the burden of loss.

The opinion has been expressed that any increase to the textile piece trade in dyeing and finishing charges would mean the closing down of many manufacturing businesses. It is not understood how, after the many lean years through which it has passed, the young British dyestuff industry is expected to be sufficiently robust not only to carry on under increased cost of production through the crisis, but at the same time to subsidise in part the ancient industry it is its normal function to serve.

The low union piece dyeing trade of Leeds suffered a loss last month in the death at the age of 71 of Mr. Joe Haigh, late principal of the well-known firm of J. Haigh and Co., piece

dyers of Wortley, Leeds. Stalwart in the trade and one of the old school, having established the business about thirty years ago when sanderswood, barwood and camwood were in general use, his genial personality will be missed by many. He used to recall the time when a 20 lb. lot of Magenta at some "fabulous" price, would be carefully delivered personally by its maker, who would not, in those days, entrust the precious burden to a common carrier. The business is being carried on under the same style by three sons.

The United Indigo and Chemical Co., Ltd., for the year ended June 30, made a net profit of £21,707. A final dividend of 5 per cent. on the ordinary shares and an extra dividend of 2½ per cent. on the preference shares are recommended, making 7½ per cent. on both classes for the twelve months.

Midlands

Most colour consumers in the Midlands have worked almost as many hours during the summer of 1926 as for the corresponding period of 1925, and are generally of the opinion that excepting for the coal dispute a much better record would have been made.

In spite of the strike wool spinners are doing slightly better than a month ago, but it must be realised that half the autumn trade has been lost, and the present manufacture is for winter goods. Woollen hosiery dyers are getting a little more business, and knitted woollen fabric for sports clothing is in slightly better demand.

Artificial silk hosiery is about the same as a month ago. Natural silk hose is being made in small bulk, and rather more inquiries for suitable dyestuffs have been received. Cotton hose is very slow, but a few orders for export have been secured. Knitted cotton fabric for football jerseys has been in better request. There is a limited demand for cotton fabric for swimming costumes, mostly for export.

Tanners of heavy leathers are still very short of orders. Coloured glazed kid is selling, but black kid is not in demand.

Prices for direct, chrome and acid colours are about the same as last month; in some cases slightly lower figures have been accepted. Vat colours are, however, cheaper by 5 per cent. to 10 per cent. over most of the range.

Scotland

All classes of manufacturers are now holding on in the hope that the present tentative movements towards peace in the coal industry will develop towards a successful result during the next week or two, and that the small rush of orders which has been promised on all hands will then materialise. Some immediate increase there must necessarily be in making up arrears, but whether this will extend into anything more permanent remains to be seen. However, even if the only advantage to be expected from a settlement were a drop in the price of coal, this alone would come as a very welcome relief, as the high figures ruling have tended to swallow up any profits that it has been possible to squeeze out of the present difficult circumstances.

As far as dyestuffs themselves are concerned, the August sales were about on the same level as the previous month, and dyes have had on the average a moderate amount of business. The textile industries, too, show very little change from last month. Scotland is to have a new artificial silk factory at Kirkcudbright. Northern Ireland has been as badly hit as anywhere by the stoppage, and in the linen trade, which was already bad, the effect of the last few months has been in some cases to hasten disaster.

British Visada, Ltd.

An attractive pamphlet has been issued by this company, giving a short account of the development of the artificial silk industry and containing views of the company's new Python Mill at Littleborough, Lancashire, and of the various departments. In a short foreword Sir Edwin Stockton, chairman of the company, states that the whole of the machinery and equipment is entirely of British manufacture, which is in furtherance of the policy initially outlined by the directors. The intention of the management is to produce an artificial silk yarn of the highest quality and wherever possible to supply silk manufacturers in Great Britain with the product of British work.

The Dyestuffs "Who's Who": (7.)—Mr. James Baddiley

THE chief chemist of a great chemical organisation needs first and foremost a thorough grasp of his subject, and of Mr. James Baddiley, who holds this position in the British Dyestuffs Corporation, it can be said that he fulfils this requirement in the highest degree.



MR. JAMES BADDILEY

Mr. Baddiley is a Yorkshireman, and received his early training at Bradford Grammar School, proceeding to Leeds University, where he graduated with first class honours in the Chemistry and Tinctorial Chemistry Schools. After a period devoted to research work with Professor A. G. Green, he joined Levinstein, Ltd., as a research chemist in 1909, and has thus been associated with the British dyestuff industry for 17 years. Numerous patents taken out during 1909-1914, for the manufacture of in-

termediates and azodyes, testify to his activity during this period.

The outbreak of war in 1914 gave Mr. Baddiley his opportunity. It became urgently necessary to extend rapidly the

range of dyestuffs made in this country and—perhaps a more difficult problem—to manufacture at once intermediates formerly imported from Germany. Mr. Baddiley took charge of the rapidly growing Research Department of Levinstein, Ltd., and results were speedily forthcoming. He has the qualities of enthusiasm and tenacity of purpose, and the knack of imparting them to his subordinates. These qualities have stood him in good stead during the difficult years following the end of the war. The marked improvements in the range and quality of British dyes and in works technical efficiency are due in large measure to Mr. Baddiley's chemical leadership. At the fusion of Levinstein, Ltd., and British Dyes, Ltd., Mr. Baddiley took charge of the joint technical research and a little later became chief chemist to the whole Corporation, a post which he fills with distinction.

Dyestuff Licences for August

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during August, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 413, of which 368 were from merchants or importers. To these should be added 9 cases outstanding on July 31, making a total for the month of 422. These were dealt with as follows:—

Granted, 359 (of which 339 were dealt with within 7 days of receipt).

Referred to British makers of similar products, 38 (of which 33 were dealt with within 7 days of receipt).

Referred to reparation supplies available, 3 (all of which were dealt with within 2 days of receipt).

Outstanding on August 31, 1926, 22.

Of the total of 422 applications received, 375, or 89 per cent., were dealt with within 7 days of receipt.

Odours in Finished Fabrics**Causes and Remedies**

ODOURS in cloth after it is finished, sometimes not becoming particularly apparent until after the fabrics have been shipped, are a problem often encountered by woollen mills. According to the Research Department of the Procter and Gamble Co., U.S.A., these odours generally emanate from two sources—soap or oil. The analysis made by the chemists states that, as a rule, the most commonly met with odour is due to the presence of soap that has not been completely removed from the yarn or pieces before dyeing. A mill may be running continuously on one kind of fabric, exercising the greatest care in handling the wool from the bale until the cloth leaves the presses, and yet find an odorous piece here and there.

At some time during the handling, if the yarn or pieces are suddenly immersed in a cold water wash upon being removed from a soap scour, a persistent soapy odour will cling to the wool. This has been observed to happen where the goods have been removed from the fulling mills and plunged into cold water. Again, if too strong a soap solution has been used in the scouring and afterwards the rinsing done with too small a volume of water at too low a temperature, a soapy odour will result. Rinsing, to be effective, must be done with soft water and at a little more than lukewarm temperature. A good rinsing temperature is 110° F. If the soapy odour in the cloth appears in every piece then the difficulty may be attributed to the soap itself. It seems to be the property of some soaps to "hang on" even though the fabrics have been apparently thoroughly scoured. Under these circumstances, the manufacturer will find it to his advantage to change soaps.

In the case of oily odours, the remedy is in scouring the goods repeatedly and in guarding against the use of wool oils that have a pronounced odour. In order to card and spin wool stock it is necessary to add oils mixed with water and a milk alkali, so as to lubricate the fibres, making them more pliable. This prevents damage to the fibres in carding, minimises waste, and facilitates spinning. Olive, lard, and red

oils or mixtures of these with different mineral oils are generally used. Most oily odours are due to these mixtures. Naturally they are lower in cost, but in the long run are poor economy if extra time is required in the washroom to get fabrics clean or streaked dyeing is a result.

Around the Works**(8.)—The Colne Vale Dye and Chemical Co., Ltd.**

THE dyestuff and chemical manufacturing concern now known as The Colne Vale Dye and Chemical Manufacturing Co., Ltd., of Milnsbridge, Huddersfield, was founded in 1858 under the title of Dan Dawson Brothers, who had their works at Milnsbridge. Dan Dawson Brothers were among the first manufacturers in this country to produce Magenta. Shortly afterwards they were able to manufacture Soluble Blue, which was very soon followed by Chrysoidine and Bismarck Brown. Thus they kept pace with the increasing demands of the times. To-day, sixty-eight years after the original foundation, the works of the Colne Vale Dye and Chemical Co., Ltd., stand on the same site as the original factory of Dan Dawson Brothers. The concern has steadily grown till it now produces every class of dye for the following trades:—Textiles, paper, jute, leather, straw and wood-chip, ink, paints and varnish, including among many others Basic Magenta, Acid Magenta, Soluble Blues, Ink Blues, Induline, Nigrosine, Bismarck Brown, Chrysoidine, etc. At the Milnsbridge works, in laboratories fitted out on the most modern scientific lines, a competent staff of trained chemists is constantly engaged not only in the endless tests which are required to keep the manufactured products up to the highest possible standard, but also in research on the production of new colours. A special sample matching department is maintained, wherein a trained staff of experts is engaged in the important task of matching of samples supplied by clients. The company, in its sixty-eight years of successful manufacturing experience, forms a connecting link between the early efforts of the British pioneers and the present world-wide synthetic dyestuffs industry which is based on their work.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

The Industrial Position

THAT the end of the month will see the end of the coal strike will probably prove to be a sound forecast, and though chemicals and dyestuffs have suffered in consequence of the stoppage of home coal supplies there is no reason for a pessimistic view of the present state of affairs. Despite all the difficulties, supplies of British-made dyestuffs continue to be adequate, and prices on the whole remain steady, with a tendency to droop a little in places. There has been some occasional delay in delivery, and the quality available has not always of late been quite normal. In the last Dyestuffs Supplement attention was drawn to the reductions that had been made in certain classes of dyes. Now it is reported that dyers of cotton yarn and piece goods have revised their price lists in a downward direction.

A Dyestuffs Rumour

A MANCHESTER journal last week gave publicity to a rumour of a possible amalgamation between Brunner, Mond and Co. and the British Dyestuffs Corporation, but no confirmation has yet appeared. Without in any way giving credence to rumours of this kind, it may be pointed out that there is nothing inherently improbable in such a move. The German dyestuffs industry is no longer a single concern; it is linked up with a series of allied industries. Assuming this idea to be sound in the German case, there is no reason why it should not be sound in the British case. It has been, we believe, publicly stated that the organisation of the British Dyestuffs Corporation is capable of handling a very much larger range of products than dyestuffs alone, and an extension of its activities would be no great surprise. The linking up with a world organisation such as Brunner, Mond and Co. would, of course, be an obvious advantage in such matters as distribution and sales, as well as in actual production. We have, however, no definite information on the subject, one way or the other, and what has been stated must be treated as purely matter of opinion.

Mr. Ireneé du Pont's Paper

OUR readers, after a study of the paper by Mr. Ireneé du Pont on the American dyestuffs industry, the full text of which we publish to-day, will probably agree that it is one of the most notable recent utterances on the subject. In the first part he shows from figures for the years 1914, 1919, and 1925, that during the period of the war the United States definitely passed from an importing nation to a producing nation. In 1914 the United States imported (the figures are in units of 1,000 lb.) 45,947 lb. of dyestuffs; in 1919 it produced 63,401 and imported 3,290; by 1925 it was producing 86,344 and importing 5,210. His conclusion is that the complete embargo for the years 1914 to 1919 resulted in the establishment of "a real dyestuffs industry" in the United States, but that, so far as tonnage is concerned, the dyestuffs industry has not made commensurate progress during the period when tariff protection was relied on for its stimulation. In the case of vat colours, he claims, the tariff protection has not been sufficient to enable American manufacturers to produce the country's requirements; in fact, the 1925 importations were 75 per cent. greater than those for 1924 as a result of a reduced tariff. In the United States, as in this country,

the importing class has urged that an unfair burden has been put on the user or consumer of dyes. On this point, again, Mr. Ireneé du Pont quotes figures to support his conclusion that the complaint is not justified. This restricted business aspect of the subject is interesting as showing the resemblance between the history of the modern dyestuffs industry in both countries.

Indirect Commercial Advantages

OF wider general interest but not less valuable as indicating the ultimate or potential benefits of a dyestuffs industry is the list of commercial advantages enumerated by Mr. Ireneé du Pont that have followed from the establishment of the industry. These include the production of rubber accelerators, the effect of which has been enormously to increase the mileage of automobile tyres at a comparatively trifling cost; the discovery of an anti-knock fuel for internal combustion engines, which has also resulted in an enormous increase in the mileage per gallon of gasoline; the combination of certain organic solvents with nitrocellulose to form a new variety of lacquers; the discovery of flotation agents by which ores may be separated from their gangues; the production of many preparations for the treatment of specific forms of disease; and the power given to people to-day to colour any article of use or luxury according to their tastes. These may be described as collateral benefits obtained from the organic chemical research that is at the basis of dyestuff production, but they are none the less weighty assets to be brought into the account when the results are being balanced.

A Vision of the Future

MORE remarkable in some ways than these features of the paper is the vision of the future which a great commercial man like Mr. Ireneé du Pont sketches in his concluding passages. It confirms the impression that the American business mind, hard and calculating as it is on some sides, retains an almost childlike quality of mysticism and imagination. Among the suggested possibilities of the future are the production of synthetic liquid fuel and other things by the new method of high pressure synthesis; the control and utilisation of solar energy; the discovery of some organic substance that may practically abolish rust by preventing the formation of oxide; the production of some chemical means of reducing the period of time required for sleep and proportionately adding to the hours of conscious existence; and finally some chemical control of moral, mental and physical characteristics. All this, it may be said, belongs to the world of the dreamer and the mystic, not to the practical realm of science or business. And yet the greater kind of scientist has always had the elements of the visionary within him, and has had in view the broad welfare of mankind rather than the development of profit-making inventions. Something of this spirit was exhibited at the discussion on "Hormones" at the recent London Congress of Chemists, and it is interesting to compare the prophecies of Mr. Ireneé du Pont with the remark of Sir Alfred Mond at the Hormones conference that as a chemist he looked forward to the time when we might control genius, morals and sex by obtaining the correct chemical reactions. Comparison may also be made with the philosophic address of Dr. M. O. Forster

to the Indian Science Congress of last year in which the possibilities of character being determined by underlying chemical factors were explored. It would seem that especially in the field of biochemistry we may be on the verge of some quite staggering advances.

New Colours

SCOTTISH DYES, LTD., announce a new colour, Solway Light Blue R, which has been specially brought forward to provide a bright fast-milling blue. Its fastness to chrome is described as remarkably good, and the chromed dyeings have excellent fastness to both milling and potting. Where fastness to milling is not an essential requirement, it may be used as an acid colour without chroming. It is dyed by the usual process, using from 2 per cent. to 3 per cent. of acetic or sulphuric acid and from 10 per cent. to 20 per cent. of Glauber's salt. Chroming may be carried out by the "on chrome," "monochrome," or "after chrome" methods. Cotton and acetyl silk effects are left white. It may also be used for silk, and when dyed with an aluminium mordant gives excellent fast-to-washing shades. The patterns show $\frac{1}{2}$ per cent. and 2 per cent. dyeings on woollen yarns, giving roughly the Cambridge and Oxford tones.

HICKSON AND PARTNERS, LTD., of Bradford, forward a pattern card of their Sulphur Brown M, prominent among the sulphur browns for its superior fastness to washing and light.

The Dyeing of Leather

DYED textiles loom so large in everyday life that other important applications of dyestuffs are apt to be overlooked. A case in point is the dyeing of leather. The Shoe and Leather Fair held from Monday to Friday at the Agricultural Hall, London, provided a welcome opportunity for the inspection of the dyes and chemicals used in the leather industries and of the final products obtained. The firms exhibiting dyestuffs and related products included the British Dyestuffs Corporation, Williams (Hounslow), Ltd., and the Yorkshire Dyeware and Chemical Co., of Dewsbury. In addition, pigment finishes and dyestuff products were shown by the Kepec Co. (Eng.), Ltd., of Otley, Yorkshire, and Reiner and Co., Inc., of Bermondsey, London. Though the properties of leather place certain limitations on the use of dyestuffs, yet a large number are already used for dyeing leather, and also in stains and polishes. For example, the British Dyestuffs Corporation offers for the dyeing of shoe leathers 14 direct colours, 24 acid colours, and 8 basic colours. To these must be added a further 25 acid colours and a further 16 basic colours for the dyeing of vegetable tanned fancy leathers. Williams (Hounslow), Ltd., and the Yorkshire Dyeware and Chemical Co., Ltd., also offer a large range of colours. The coloured leathers shown were of remarkable variety, a special feature being various two- and three-coloured exhibits.

The young chemist who is looking for an outlet for his energies might do worse than turn his attention to the dyeing of leather. The problems to be solved here are probably much more complicated and difficult than those which arise in other branches of dyeing practice. As a result of this, and also of the undue modesty of mankind as regards the colour of its footwear, much more attention has been paid to textiles. Leather, however, finds applications in so many directions that there is clearly scope for much work.

Dyestuff Licences for September

THE monthly statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during September, furnished to the Board of

Trade by the Dyestuffs Advisory Licensing Committee, shows that the total number of applications received during the month was 546, of which 497 were from merchants or importers. To these should be added 22 cases outstanding on August 31, making a total for the month of 568. These were dealt with as follows:—Granted, 489 (of which 465 were dealt with within 7 days of receipt); referred to British makers of similar products, 62 (of which 47 were dealt with within 7 days of receipt); referred to reparation supplies available, 9 (all of which were dealt with within 2 days of receipt); outstanding on September 30, 1926, 8. Of the total of 568 applications received, 521, or 92 per cent., were dealt with within 7 days of receipt.

Catching the Student's Eye

WHEN dealt with by an inspiring lecturer, dyestuffs can be a very fascinating subject of discussion; in other hands few subjects (as some of us remember from our student days) can be so boring. The elements of the subject, in particular, have been dealt with so often that the whole matter seems cut and dried to the last degree. But an article in the September number of our American contemporary, the *Journal of Chemical Education*, affords a really astonishing example of what can be done to make the subject interesting to the duller of students. The article in question is written by Mr. R. E. Rose, of the du Pont de Nemours Co., and in the space of thirty-four pages it deals with the history of synthetic dyestuffs from their infancy to the present time. Each dyestuff mentioned (to a total of about 50) is actually exhibited, a small piece of fabric dyed with it being fixed to the page, and the article is further illustrated by portraits of some of the great workers in this field. The net result is that the reader is provided with a self-contained account of the subject in its historical, chemical, and industrial bearings. This article must have been an expensive production, but it justifies itself in every way. Even the most case-hardened dyestuff chemist is likely to find an hour of real pleasure in reading it; and it is served up in so palatable a form that a student whose ideas of organic chemistry may be quite elementary will readily absorb it.

U.S.A. Dye Fastness Tests

AFTER a long course of painstaking research work, the United States Bureau of Standards has completed its extensive natural tests for dye fastness, undertaken in co-operation with prominent textile manufacturers and associations of textile chemists, the latter group including the American Association of Textile Chemists and Colorists. Eleven thousand samples of cotton, wool, and silk have been tested for dye fastness under actual conditions of processing and exposure to various sunlights, weather, and other natural colour-destroying agents. It is expected that a voluminous report will be issued at an early date, outlining the results of the work with technical comment as to the effects of various sunlights on dyed material, and recommendations as to the most suitable processes to be employed in dyeing cotton, wool, and silk.

Dyestuff Imports into Spain

THE Barcelona Chamber of Commerce has decided to urge the Government to avoid keeping in force longer than is necessary the provisional restrictions of imports into Spain of dyes not produced in that country, to draw up as soon as possible a list of the dyes which the national industry produces in the quantity, quality, and price required by consumers, to establish in Barcelona a commission which would decide finally on the import permits, and to allow the importation of synthetic dyes only through the Barcelona Custom-house.

The U.S.A. Dyestuffs Industry—Forerunner of What?

By Irene du Pont

We have pleasure in publishing below the text of the important paper on the United States Dyestuffs Industry, presented by Mr. Irene du Pont, a former president of I. E. du Pont de Nemours & Co., at the Philadelphia Meeting of the American Chemical Society.

SOME seven years ago the American Chemical Society, at its meeting in Philadelphia, passed the following resolution:—

Whereas the establishment of a complete self-sustained coal-tar chemical and dye industry is a national necessity because of its well-defined character as a key industry in our economic life; and

Whereas this industry has a much deeper significance in that it constitutes a vital reserve both as to personnel and supplies for our Army and Navy in modern warfare; and

Whereas this industry is also essential for supplies of synthetic drugs for the health of the Army, Navy, and general public in peace and in war; and

Whereas this country possesses an abundance of raw material for such an industry, ample capital and chemists capable of solving the many scientific and technical questions involved, as evidenced by the splendid progress of the past three years; and

Whereas this initial period, with all of its attendant difficulties has not yet been adequate to admit of the efficient production in domestic plants of all colours needed by American consumers; and

Whereas the greatly depreciated rate of exchange in that country which in the past has manufactured the bulk of the world's supply of dyes presents a new and threatening factor in all transactions of an international character: Therefore be it

Resolved, first, that we urge all Americans to stand loyally by the young industry which embodies such far-reaching potentialities of service and protection for our country.

Second, that every needful safeguard be thrown around this industry by the Congress of the United States, especially through the imposition of effective import duties and the provision of a temporary licensing system along the general lines embodied in H.R. 8078 as the Longworth Bill.

It seems, therefore, appropriate to review, in the light of the years which have elapsed, the progress made in the dye industry, and also the progress made in analogous chemical industries, which progress is dependent on the same character of reactions, apparatus, and personnel as the dye industry.

Statistical Comparisons

Progress in the dye industry can be broadly measured by a comparison of (1) the volume of manufacture measured in pounds; (2) the variety of products made; (3) the selling prices of the dominating items.

For this purpose it seems proper to choose for the comparison the years 1914, largely before the world war, when the United States was dependent on Germany for its supplies of dyestuffs; 1919, immediately after the world war, which had caused a period of five years of substantially complete embargo of the importation of dyes; 1925, the most recent year available after a period of tariff protection.

The following table is from data of the United States Department of Commerce (the figures are in units of 1,000 pounds) and takes no cognisance of the improvement in tinctorial power in the products in the later periods.

	1914	1919	1919	1925	1925
	Imports	duction	Imports	duction	Imports
Acid	9,286	12,196		10,214	590
Basic	3,002	4,036		4,122	608
Direct	10,264	14,445		14,788	759
Lake and Spirit					
Soluble	1,512	1,813		1,606	58
Mordant and Chrome	4,450	3,985	24	2,543	642
Sulphur	7,054	17,624		20,700	122
Indigo	8,407	8,864	1,051	20,122	2
Other Vats	1,945	389		2,608	2,417
Unclassified	27	49	2,215	581	12
	45,947	63,401	3,290	86,344	5,210

It takes but a cursory examination of these figures to show that the complete embargo for the years 1914 to 1919 resulted in the establishment of a real dyestuffs industry in the United States, and that so far as tonnage is concerned the dyestuffs industry has not made commensurate progress during the period when tariff protection was relied on for its stimulation. It is quite striking to point out, however, that in the case of indigo and sulphur colours, which have a low selling price and are protected by a prohibitive tariff, satisfactory growth has continued.

In the case of vat colours the tariff protection has not been sufficient to enable American manufacturers to produce the country's requirements, and, in fact, 1925 importations were 75 per cent. greater than those for 1924 as a result of the reduction in tariff from 60 per cent. to 45 per cent. *ad valorem* in September, 1924.

From the best data obtainable the du Pont Company believes that there were made in the year 1914 about 104 different dyes and these largely from imported intermediates; in 1919 it is estimated there were 250 types of dyes manufactured; in 1925 the estimate is at least 350 different dyes. This, too, indicates that the embargo due to the world war fostered progress in developing the art in this country. The apparent lessening progress since is partly due to the approach of the "saturation point" with respect to the number of dyes actually required in industry and partly to an effort to eliminate inefficient and needless dyes.

From both these comparisons it appears that the resolution of the American Chemical Society, above referred to, was well warranted from the point of view of the dyestuffs manufacturing industry. Now let us consider whether it has been a burden on the users of dyes and, therefore, on the ultimate consumer of goods requiring dyestuffs. It would require too much space to enumerate the corresponding prices on every dye that is sold. To group them by classes would be misleading because of the interchangeability of many dyestuffs with different values. However, there are dominant dyes comprising a large proportion of the total tonnage which are comparable for the different periods.

Selling Prices

The following table gives the current selling prices for the period 1913-1914, the year 1919 and the year 1925. The prices given in columns 2, 3 and 5 are for an amount of the dye which would give tinctorial power equal to a pound of the dye as sold in the earlier year. Columns 4 and 6 have been added, being respectively 58 per cent. and 59 per cent. of the corresponding figures in columns 3 and 5 to allow for the shrinkage in purchasing power of the dollar in the latter periods. The purchasing power of the dollar, 58c. for 1919 and 59c. for 1925, represents its average purchasing power as measured by the cost of living in average American communities as published by the National Industrial Conference Board.

	1913-1914		1919 Price		1925 Price	
(1)	(2)	(3)	(4)	(5)	(6)	
Indigo 20% Paste ..	15½c.	75c.	43½c.	14c.	8½c.	
Sulphur Black, pre-war type, Single Strength	17c.	20c.	11½c.	11-12c.	7c.	
Direct Deep Black E Extra	20c.	1.00	58c.	33c.	19½c.	
Agalma Black 10 BX	27c.	1.45	84c.	54c.	32c.	
Orange II Conc.	10c.	63c.	30½c.	29c.	17c.	

This data clearly disproves the claim made by certain importers that embargo or high tariff would put an undue financial burden on the user or consumer of dyes.

Closely related to dyestuffs are certain other organic materials which are of great importance in that they supplement the dyestuffs industry, broadening its scope and giving a greater horizon for future discovery. Without boring you with comparative tabulations showing the growth of these, let it be said that the total amount made in the United States in 1914 was negligible, whereas for the year 1925 we have the following imposing business:—

Product	Sales Pounds	Value \$	Production Pounds
Photographic Chemicals..	349,000	475,000	327,000
Medicinals	3,295,000	6,332,000	3,238,000
Flavours	2,149,000	1,409,000	2,207,000
Perfumes	2,371,000	884,000	2,335,000
Synthetic Tanning Materials	13,897,000	8,699,000	14,687,000
Synthetic Phenolic Resins			

What Other Industries Owe to Dyestuffs Research

After this general view of the situation, let us take up some specific accomplishments which are outstanding from a commercial point of view.

One of the most notable is that class of compounds known as rubber accelerators. In 1906 Oneslager discovered that aniline had an accelerating action in the curing of rubber, but for a decade little attention was paid to its possibilities. Then came discoveries of less poisonous materials of greater power until in 1925 we find that there were produced in the United States for this purpose

	Lb.
Diphenylguanidine	1,204,700
Thiocarbanilide	2,352,000
Triphenylguanidine.....	494,100
Hexamethylenetetramine	1,658,000

These compounds not only have the property of hastening the curing process in the manufacture of rubber goods, but to a considerable extent improve the quality of the rubber into which they have been incorporated. Dr. W. C. Geer, in his paper read before the American Chemical Society a little over a year ago, stated that these chemicals were saving the American public at the rate of \$50,000,000 per annum, and by their speeding up manufacturing processes had saved the rubber manufacturers \$80,000,000 additional capital investment which would otherwise have been required.

One of the large rubber companies has made an estimate that the increased mileage of tyres made with accelerators over the mileage which would have been obtained without such ingredients has in the last ten years aggregated 240,000,000,000 tyre miles, or equivalent to sending 2,500,000 automobiles around the world at its equator. The total cost of these accelerators has been but a small fraction of the value of the results obtained.

Another outstanding accomplishment is the invention of the so-called anti-knock for gasoline used in internal combustion engines. It is well known that the thermal efficiency of an internal combustion engine increases quite rapidly with the degree of initial compression put upon the mixture of fuel and air before its ignition, and that, unfortunately, when a pressure is reached which is quite definite for any particular fuel, the nature of the explosion in the engine suddenly changes, producing what is known as a "knock"; that this knock is occasioned by a nearly instantaneous and very high pressure explosion in which a large proportion of the energy is given out as radiant energy to be absorbed by the walls of the cylinder and, therefore, not available for mechanical work on the crank shaft. The critical pressure which induces a knock is far below that which could be easily obtainable mechanically.

Mr. Thomas Midgley, of the Dayton Engineering Laboratories, in his investigation of the cause of "knocking," discovered that adding small amounts of certain compounds to the fuel materially changed the pressure at which knocking was produced. He finally found tetraethyl lead whose properties in this regard are quite astonishing. Amounts as small as one-twentieth of 1 per cent. of the fuel are ordinarily sufficient to permit an increase of 50 per cent. in the initial compression, with a corresponding increase in the efficiency of the motor using it. It is now certain that the mileage of automobiles per gallon of gas can be increased 50 per cent. by its use. Consequently, one-third of all gasoline used can be saved by the use of this compound. If it had been universally applied in the year 1925 this would have resulted in a saving of some 3,000,000,000 gallons of gasoline. One may reasonably expect that this saving actually will be obtained within a very few years. It will, of course, require changes in automobile design.

Another extraordinary use of organic compounds is the combination of certain organic solvents with nitrocellulose to form a new variety of lacquer. In the past two years finishes of this kind have largely supplanted coach paints and varnishes for finishing automobiles and are making rapid inroads in many other industries. I am advised by one automobile body manufacturing company that if such lacquers had not been available they would have had to spend \$10,000,000 for additional paint shops and drying equipment to take care of the increase of their business in the last two years. For commercial reasons, presumably, they have not divulged the economy in operation, though it is known to be very large. The great value of the invention has been to the

ultimate consumer (the automobile owner), because this class of finish will outlast two or three applications of the old-fashioned type. This not only reduces the average per annum cost of repainting, but the car is in the paint shop less often, and because of the rapid drying of the new finish, is out of use for a much shorter time.

Possibly many of you do not appreciate the extent that organic chemistry has contributed to metallurgy. The process known as "Flotation" started with the use of coal tar oils which could be had at a very low cost. It has been more recently discovered that mixtures of certain purified organic reagents, such as alphanaphthylamine and xylydine and later thiocarbanilide and orthotoluidine, secured more accurate selection of the desired ores from the pulverised run of mine. Still more recently potassium xanthate has taken the lead for this purpose. The dyestuffs industry was peculiarly able to supply these reagents in large quantities at reasonable costs. Data from twenty-five leading mining companies producing copper in the year 1925 indicate that 63 per cent. of their output, or 1,481,000,000 lb., was produced by the aid of flotation.

We all know that insignificant amounts of certain organic chemicals properly applied have wonderfully decreased the ravages of disease and increased correspondingly the length of effective life. Attention has been called above to the fact that small quantities of compounds of the accelerator class enormously increase the mileage of automobile tyres at a comparatively trifling cost; that the use of tetraethyl lead will cause an enormous increase in the mileage per gallon of gasoline used in automobiles and this, too, at an insignificant cost; that new finishes have been obtained resulting in very large savings; that flotation agents have been obtained by which ores can be separated from their gangues; that the dyestuffs industry enables man to colour his every product according to his desire—surely as great a diversity of benefits as could well be imagined.

Possibilities of the Future

We know that theoretically many millions of organic compounds may be prepared, each with different properties. Is it not then likely that there remain undiscovered compounds of even more surprising potentiality for the welfare of mankind? Without wishing to appear visionary, let us consider a few possibilities.

Experimental research has already developed a possibility of making liquid fuels for internal combustion engines which will take the place of gasoline should the supply of this fuel become exhausted; this through the route of high pressure synthesis of carbon monoxide and hydrogen to form methanol; and, in fact, this synthesis of methanol is being successfully accomplished on a commercial scale in Germany. The same new tool, high pressure synthesis, has in the laboratory made hydrocarbons. It is, therefore, hardly a prophecy to say that this will be commercialised for the benefit of the human race. The synthesis of starches and sugars may be reasonably expected to follow at a more distant date.

The use of the radiant energy of the sun as a source of power has long been a problem substantially unsolved. A few experimental sun heated boilers have been operated, but no real commercial success has been attained. Nature's laboratory in the leaves of plants proves that radiant energy can be stored through the use of organic reactions. Is it not reasonable, then, to suppose that this problem particularly fits solution by the organic chemical route and would it not seem equally reasonable to suppose that reactions will be found far more efficient than those provided by Nature in growing vegetation? Bear in mind the solution may be one with a deferred yield of either light or electricity.

It is estimated that corrosion of iron is proceeding the world over at a rate about equivalent to the rate that iron is manufactured in Great Britain. Alloys, known as rustless steel, have already been made, but they are too expensive for use where cost per unit is important. Is it out of the question to find an organic material which can be absorbed into the pores of the iron itself, or possibly forced into them which will then have the property of preventing the formation of the oxide?

We know that some adults sleep more hours than others. It seems likely that this is due to some slight differences either of the nature of the more quickly accumulated poisons

which necessitate sleep for their removal or a less rapid elimination of those poisons by those who sleep less efficiently. Would it not seem also likely that the reactions may be hastened by some catalytic agent or even that the antidote itself may be prepared and administered, thereby either decreasing the amount of sleep required, or even doing away with the necessity of sleep entirely? It is interesting to note here that I asked Professor Steiglitz his view on such an apparently absurd question. His reply was that it would be like having a fire without a chimney—perhaps a cryptic answer, especially as we have seen in recent years the introduction of the electrical resistance furnace, and more lately the induction furnace, both of which do operate without a chimney. Such a discovery could add some 50 per cent. to both our hours of production and our hours of pleasure, and by its complete accomplishment would greatly decrease the cost of housing and the capital cost per unit of production of all those factories which to-day do not operate on a twenty-four-hour schedule.

Certain drugs tend to stupefy and prevent humans from thinking clearly; other drugs, such as caffeine, as usually taken in tea and coffee, surely to some extent stimulate the mind with apparently no corresponding later depression. Is it not reasonable to suppose that there exist other compounds which might stimulate the mind to greater extent so that mentally all the users would become supermen or geniuses? Would not research with this end in view be worth while, in view of the advantage to humanity were it successful, and thereby all men become intelligent and alert?

You must have experienced in your lifetime cases where

most lovable characters as they grew older became crabbed, intolerant, melancholy, or in some other way deteriorated. It is proverbial that if one's liver is out of order it definitely does affect one's outlook on life for the worse, and there can be no question that the liver's function is essentially a chemical one. You probably have observed cases where children after an operation for adenoids or defective tonsils have become much less bashful, have improved in their studies, have become more cheerful, in short, have become brighter. It seems reasonable to suppose that they had been troubled by some secretion affecting their mental processes. Other organs and glands presumably have analogous effects, so much so that it does not seem to be unreasonable to suppose that one's character itself is the result of the sum total of certain chemical reactions taking place in the body. When the nature of these is understood, may we expect that by injecting proper compounds into an individual we can make his character to order? If study and experiment can reach this result, it would seem to be a short cut to the millennium.

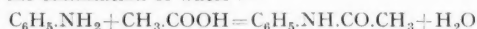
Why has no greater progress been made in devising new uses for organic compounds? It would seem to me clear that the main cause is the time required for making experiments; especially where effect on human beings is concerned, experimentation apparently becomes extremely slow. We can speed up a given experiment a little, but not much. Improvement in this regard must lie in carrying on multiple experiments by an army of trained observers. Trained observers are surely learning to reduce their observations to writing so that others may compile the results with the work of their fellows. To my mind this is the portal to the rapid progress which will be made in the future.

Basic Intermediates for Dyestuffs: III.—Paranitraniline and Paraphenylenediamine

By "Consultant"

THE compounds obtained by the nitration of acetanilide and by the reduction of the nitro bodies so produced form a series of compounds of paramount importance for the preparation of dyes of the azo class. Paranitraniline, for instance, is invaluable as a primary compound for the preparation of dyes of the simple azo type, and enters into the composition of a number of developed orange and red shades, whilst the use of paraphenylenediamine lies mainly in the production of disazo blues.

Acetanilide, the raw material for this series, is fairly easily obtained by the direct combination of aniline and acetic acid with the elimination of water:—

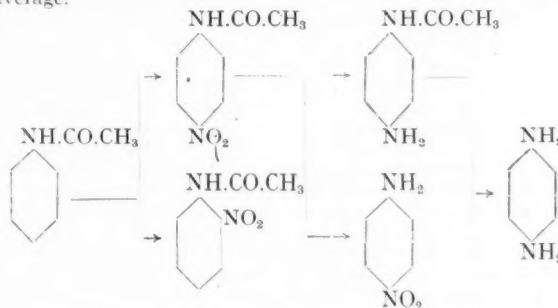


On the manufacturing scale the aniline and acetic acid are mixed, not in equimolecular proportions, but with an excess of acetic acid. This excess of acid distils off during the final stages in the preparation and carries with it a great part of the water formed. In actual practice equal quantities of aniline and acetic acid (1 cwt.) are mixed in a stout aluminium vessel fitted with a still-head, and the mixture subjected to the following heat treatment. During the first twelve hours the temperature is kept down to 110° C., but during the following twelve hours a slight rise to 130° C. is permitted. After a six hours heat at 140°–150° C. the temperature is allowed to rise to 240° C., during which period the excess of acetic acid and the water formed during the reaction distil off. When nothing more comes over the melt is allowed to cool somewhat and poured into a vat containing 120 gallons of water warmed to 50° C. By this operation the acetanilide is granulated, and after cooling to allow a certain amount of dissolved product to crystallise out, the batch is filtered off, dried and ground. The yield is very good and averages 95 per cent.

The series of operations which acetanilide goes through in the production of nitraniline and phenylenediamine is shown diagrammatically in the scheme below. Nitration gives both ortho- and para-nitroacetanilide from which the corresponding nitranilines are readily obtainable, while by suitable reductions the paraphenylenediamine may be obtained, either directly

from the paranitraniline or through the intermediate stage of amino acetanilide, itself an important dyestuffs product.

In commercial practice the nitration of acetanilide proceeds smoothly and easily, and a yield of about 80 per cent. is the average.



The acetanilide is ground finely and added (1 cwt.) slowly to concentrated sulphuric acid (4 cwt.) at a rate which does not cause the temperature to rise above 30° C. The mixture is cooled to 0° C. and "nitration acid" run in slowly so that the temperature in this part of the operation does not rise higher than 3° C. Nitration acid contains about 30 per cent. of nitric acid, 50 per cent. of sulphuric acid and 20 per cent. of water. During the process of nitration very vigorous stirring is maintained, and is kept up after the addition of acid is completed until the actual process of nitration is finished—a stage which can easily be determined by the absence of free acetanilide from a test sample. At this point the reaction fluid is poured out on to a mixture of equal parts (7 cwt.) of crushed ice and water. The crystals which separated out are a mixture of ortho and paranitroacetanilide and are separated by taking advantage of the extremely rapid hydrolysis of the ortho derivative. To effect such a separation, the paste from the previous operation is stirred with water (about 5 cwt.) and alkali added until the solution is slightly alkaline to litmus. The solution is raised to 100° C.

and boiled for a few minutes whereby the ortho compound is almost completely hydrolysed to ortho-nitraniline while the paranitro acetanilide is almost unattacked and on cooling separates out in orange brown needles which are removed and dried.

Of course, the real function of the acetyl group in the nitration processes just described is to protect the amino group from oxidation, and several other processes for accomplishing this end have been described. The most interesting and simple is that which involves the formation of benzylidene-aniline (G.P. 72,173). Equimolecular proportions of benzaldehyde and aniline are warmed together when reaction takes place, and the new compound benzylideneaniline forms a layer under the water which is also produced in the reaction and can be run off. The molten benzylidene-aniline (50 lb.) is then run into 98 per cent. sulphuric acid (1½ cwt.), during which operation the temperature may be allowed to rise to 50° C. The nitration acid (30 lb. 60 per cent. nitric acid and 30 lb. 98 per cent. sulphuric acid) is then allowed to trickle slowly in with constant stirring, the temperature being kept below 10° C. At the end of the reaction an equal bulk of water is added, when the combined actions of the heat produced and the excess of acid present hydrolyses off the benzaldehyde which is removed by steam distillation, leaving comparatively pure paranitraniline in the liquid. This process is stated to give rise to considerably less of the ortho derivative than the process involving acetanilide.

When para-aminoacetanilide is required, or when it is proposed to use this compound as an intermediate stage in the preparation of paraphenylenediamine, the paste of paranitroacetanilide is reduced without further treatment. In this operation the use of hydrochloric acid is barred by the fact that its action splits off the acetyl group. The reaction proceeds quite well, however, when iron with a small amount of acetic acid is used. The nitroanilide (1 cwt.) is placed with iron borings (1½ cwt.), water (34 gallons), and

acetic acid (12 lb. of 40 per cent. acid) in an iron vessel and gently heated until the reaction sets in. The reaction proceeds when once started without the aid of external heat, although it is usual to continue the boiling for a few minutes after reduction appears complete. The solution is cooled to 70° C. before neutralisation with soda ash in order to minimise hydrolysis, and the clear solution after filtration from the iron sludge is concentrated to the crystallisation point and cooled. The para-aminoacetanilide separates out in brown crystals with m.p. about 160° C. It can, of course, be purified by recrystallisation, although for dyestuffs purposes this is not usually necessary.

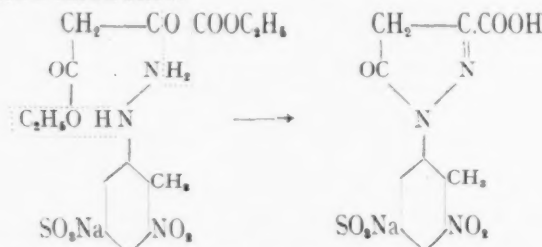
When paranitraniline is the object of the preparation the nitroanilide is hydrolysed with 35 per cent. caustic soda solution. Paraphenylenediamine can be prepared either by the hydrolysis of para-aminoacetanilide or by the direct reduction of paranitraniline. The latter process is the one more usually followed out in practice, and does not materially differ from the other reductions of the intermediate works. Paranitraniline and iron borings in equal quantities (2 cwt.) are mixed with water in a large lead lined or iron vessel together with 20 lb. of concentrated hydrochloric acid; or alternatively the iron, water and acid can be mixed together, heated, and the nitro compound added in small quantities. During the course of the reaction a certain amount of heat is supplied to the charge in order to keep up a gentle ebullition, and the volume is kept constant by the addition of water. When the reaction is over, hydrochloric acid is added and the solution concentrated, if necessary, until crystals of the hydrochloride of paraphenylenediamine begin to separate. On cooling a good crop of these crystals is obtained, and can be converted into the base by the action of warm concentrated soda solution. Works quality paraphenylenediamine, either as base or salt, is usually much discoloured by oxidation, and after storage is often quite black in colour.

Dyes and their Application: Recent Technical Progress

By L. J. Hooley

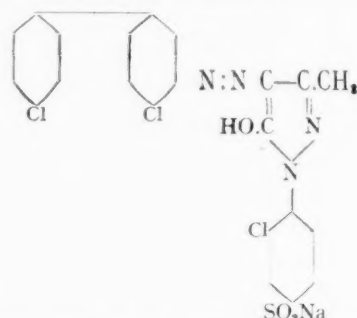
Azo-Pyrazolone Dyes

THE excellent fastness to light of the majority of the pyrazolone dyestuffs, most of which are comparatively simple in structure for azo dyes, has naturally led to attempts to incorporate the pyrazolone nucleus in more complex molecules and to extend the range of shades beyond the yellows and oranges which at present form the bulk of the series. In B.P. 252,957 (Sandoz, Böniger, M.) red disazo dyestuffs are obtained by coupling pyrazolones with diaryl-*p* diamines and aryl-*o*-hydroxy carboxylic acids. The pyrazolones used are the 1-phenyl-3-methyl (or 3-carboxy)-5-pyrazolones. The synthesis of these is also given in the patent. Starting with 6-nitro-2-toluidine-4-sulphonic acid, this is diazotised and the diazo body then reduced to the hydrazine with sulphurous acid. By condensing this with oxalacetic ester and hydrolysing, the 3-carboxylic acid is obtained, or with acetoacetic ester the 3-methyl derivative instead. The former condensation is shown below:



The nitro group is reduced with iron borings after condensation. If now two molecules of the pyrazolone are coupled with one molecule of tetrazotised diaryl-*p*-diamine the symmetrical compounds obtained are of no technical value, but if another constituent is used instead of one molecule of the pyrazolone, the resulting dyestuff dyes cotton directly and can be diazotised and developed on the fibre. Thus salicylic acid \leftarrow azo dianisidine azo \rightarrow pyrazolone azo \rightarrow β naphthol gives a bluish red.

Further yellow wool dyes, but yellow dyes which are very fast to milling, are obtained from phenyl methyl pyrazolones by coupling with monoamino diphenyl derivatives (U.S.P. 1,587,005. B.P. 253,763. Griesheim Elektron, Laska and Weber). An example is shown below:—

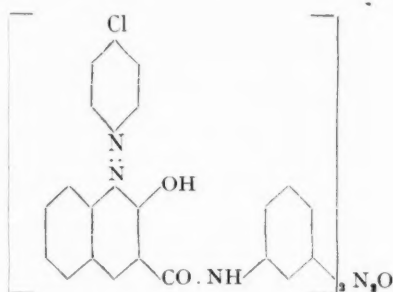


These same monoamines, which bear a slight resemblance to benzidine, may also be coupled with derivatives other than pyrazolones, and 2-6-naphthol sulphonic acid for example, when coupled with the same base as shown in the formula, gives a reddish brown, and 2-phenyl-amino-8-naphthol-6-sulphonic acid a brown. These dyes also are fast to milling.

By using 1-phenyl pyrazolones with amino groups in the phenyl nucleus, urea derivatives of pyrazolones may be produced, and one molecule of the urea then condensed with two molecules of a diazotised azo dye (U.S.P. 1,539,353 Fritasche). Coupling the urea with diazotised 4-amino-3-tolueneazo-2'-toluene-4'-sulphonic acid an orange cotton colour is obtained. Pyrazolone azo colours containing carboxylic ester groups (in either constituent) are patented in B.P. 247,224 (I.G.) for use with wool and silk mixtures. The number of free acid groups present should not be more than is absolutely necessary to make the products sufficiently soluble for use as acid dyes.

Developed Azo Colours

Interesting new derivatives of the hydroxy naphthoic arylides are described in B.P. 248,946 (Griesheim Elektron). These are symmetrical compounds of two molecules of arylides joined through the aryl nuclei by an azo or azoxy group, e.g. $[C_{10}H_6(OH)CO.NH.C_6H_4]_2N:N$. Two lines of synthesis are possible: (a) reduction of the nitro arylide of the hydroxy carboxylic acid to give the azo or azoxy body; and (b) condensation of one molecule of a diamino azo or diamino azoxy body with two molecules of the chloride of 2,3-hydroxy naphthoic acid. The most interesting point in connection with these symmetrical naphthol derivatives is that they are absorbed by cotton to a similar extent as the direct colours, and as a result the dyeings obtained after development and coupling have an advantage in fastness to rubbing compared with those obtained from the simple naphthol bases which have very much less affinity for the fibre. The patent includes a very large number of examples, mostly in yellow to red shades. The shade obtained is determined principally by the developing constituent.



The above is bluish red in substance. Similar compounds to the above are also dealt with in D.R.P. 422,467 (Cassella, Kalischer and Keller).

Shades very fast to light and kier boiling can be obtained by using the *as-m*-xylylides of 2,3-oxynaphthoic acid, developing these also with xylydines. Fuller and clearer shades are at the same time obtained than with the corresponding naphthoic anilides (U.S.P. 1,576,322, Bayer, Haller). The developed dyes give various shades of red. Development dyes for wool may be applied by impregnating the wool with a sulphonic acid derivative containing a hydroxy or other group so that it can afterwards be coupled with a diazo body, as for example naphthalene-1,5-di (2-hydroxy-3-naphthoyl amino-6-sulphonic acid), which with xylydine gives a bluish red. The naphthols are applied to silk by the I.G. in B.P. 253,865.

Meister, Lucius, and Brüning have extended the previously available blacks by the use of benzaldehyde as the azo constituent in the naphthalides of β -naphthoic acid. Cotton is dyed in black shades by impregnating with 2,3-oxy naphthoic acid, α or β -naphthylamide and then developing with diazotised *m*- or *p*-benzaldehyde azo α -naphthylamine. Fast pigments are produced from Naphthol AS and 2-benzamide-*p*-toluidine (Rohner, Sw.P. 109,706).

As considerable claims have been made for the fastness properties of the naphthols, exact data on their fastness to light will be of great interest. These are to be found in a paper by L. Loscher (*Textilber.* VII, 243). As has been mentioned before, the method of dyeing, especially the question of rinsing and soaping, has some influence on the final fastness. With Naphthol AS coupled with Fast Red GL base this effect is very marked, changing from 2-3 with cold rinsing to 4-5 with half an hour's boiling with soap. Naphthol AS-RL with Fast Red RL has a fastness of 5 (the highest degree), while the average fastness is equal to about 4.

In a different paper in the same journal (p. 11) dealing with practical details in the dyeing and printing of these colours, Kielbasinski gives an interesting note on an early attempt, with K. Bukowiecki, to fix the COOH group in oxynaphthoic acid. The method they adopted was to form the barium salt with barium chloride. They obtained better results with hydroxy naphthoic acid but not with β -naphthol. This was a few years before the Griesheim Elektron brought out their method of converting the acid group to the anilide.

The Cotton Research Institute
Points from Dr. Crossley's Report

At the recent meeting of the British Cotton Industry Research Association, Dr. A. W. Crossley reported on the work carried out by the research staff at the Shirley Institute, Didsbury, under his direction. The extracts from the report given below are from the sections dealing with scouring, bleaching, and dyeing, etc.

Steeping. *Analytical control.*—Examination of the effects of treating cottons with water or dilute acids has revealed three methods of determining the efficiency of removal of the soluble constituents during technical steeping, and therefore indirectly of measuring the mechanical efficiency of the processes. They are (a) ash content and ash alkalinity, (b) copper number, and (c) nitrogen content. The ash content which is allowable after the rot or enzyme steep of a grey cloth containing no China Clay or similar ingredients has been determined, as well as for a grey sour; and the copper number which should be exhibited after proper washing is also known. Provision for the necessary measure of the residual starch is made too. The nitrogen value, however, turns out to be of use for comparative purposes only.

Effect of the steep on subsequent scouring.—Measurements have been made on the effect of the steep on subsequent one-process scouring with caustic alkali. The chemical properties of the scoured material and its general cleanliness after washing out of the kier are directly related to the efficiency of the steep. The best whites are obtained, however, only when the steep has included a treatment with acid. This superiority is in no way associated with tendering, which causes a deterioration in the white finally attained approximately proportional to the copper number produced by the acid attack.

Scouring. *The use of "emulsifying agents."*—Small scale experiments on the effect of adding emulsifying agents to the scouring liquor have been completed. Their effect appears to be confined principally to a more efficient removal of fat and wax and to the production of a rather superior white as a result of a standard scour. The organic solvents usually recommended for the purpose are inefficient relative to the soaps, of which resin soap exerts the greatest effect on the wax content and on the removal of oil stains, though it is somewhat inferior to coconut oil soap and to good normal hard soaps with respect to the white produced. The addition of sodium silicate has a very favourable effect on the white attained as a result of scouring. Progress has been made in the investigations which deal with the action of acids and of oxidising agents on cotton. As explained in the previous report, the practical object of these studies is two-fold; first, the development of those exact methods of chemical analysis which provide authoritative statements of the extent to which cotton has been attacked by chemicals used in bleaching, dyeing and finishing processes, and secondly, the definition of limits or standards beyond which the practical textile value of cotton must be considered as unnecessarily depreciated as a result of such chemical treatments. These two points of view are illustrated in the following.

The fastness of vat dyes.—Chemical attack of almost any kind results in an increase of the measurable character of cotton which is called its copper number, and it has already been shown that copper numbers above 0.5 are very generally accompanied by unjustifiable loss in the laundry fastness of dyes. Experiments are now being made with the object of discovering whether the enhanced copper number is also accompanied by a loss in the light fastness of dyes and for this purpose cotton fabrics have been overbleached to slight but increasing extents, an operation which produces steadily rising copper numbers in the cotton. These materials have all been dyed and are now being exposed to the action of sunlight in different parts of the country, and it is expected will afford some definite indications as a result.

Loss of weight in alkali treatments.—It is one of the most valuable qualities of cotton that the material can be boiled with soda solutions without losing substance, a quality which is lost to an increasing extent as the copper number of the cotton rises. Whatever may be the nature of the chemical action which causes the damage, it is found that the percentage loss of weight experienced by cotton when it is boiled with weak caustic soda solutions is about six times the copper number.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

THE fall in the volume of business reported in the last issue of the Dyestuffs Supplement has, unfortunately, continued throughout the month of September, and there is no longer any doubt that the coal stoppage has at last obtained a stranglehold. This was inevitable, but that the result has been delayed so long is a wonderful tribute to the grit of the northern industrialist. To have led the world in industrial affairs for over a hundred years on the mere basis of coal is an achievement worthy of the highest honour, and to carry on almost normally without coal for twenty-two weeks would appear to demand the addition of an extra bar.

The opinion in certain circles here that the strike would last until October was quoted in the July report: to-day's opinion in the same circles is that the end of the month will see the end of the strike. Under these circumstances there are no grounds for a pessimistic view of the present state of affairs.

During the month it has been found necessary to curtail still further the working hours of the spinners of American cotton and for the immediate future they are only to work one week in three. While this may be in part due to the coal stoppage, there can be no doubt that it is in the main due to the dislocation of the cotton market by the drop in the price of cotton and the belief that the quantities of cotton now available—far in excess of the world's requirements—cannot but mean still lower prices. The dislocation may only be temporary, and in any case it will now be possible to test the truth of the theory that the prosperity of Lancashire depends on an abundance of cheap cotton.

Despite all the difficulties, supplies of British-made dyestuffs continue to be adequate, and prices remain steady on the whole, with a tendency to droop a little in places. In a few exceptional cases there is some delay in delivery and in a few others the quality available is not quite normal.

During the month it was reported that dyers of cotton yarn and piece goods have revised their price lists and that on the whole charges have been reduced.

Reviewing the month an observer cannot fail to be impressed by the resource and soundness displayed by the Lancashire textile, dyestuff, and chemical industries. Manchester's civic week at this anxious time is, perhaps, an indication of the general confidence.

Yorkshire

The coal stoppage is prolonged, with increasing effect on the trade in spite of small rail consignments of coal from English pits for use industrially. One hears on the one hand of competition between producers of outcrop coal with consequent lowering of prices, and on the other of growing scarcity. Different conditions obtain in different localities. A rumour has been current in Bradford that the Bradford Dyers' Association intended to close down its works for a time, owing to the difficulties caused by the coal strike, and the unsettled conditions in the Far East. This rumour, however, has been denied by Mr. George S. Haslam, a director of the B.D.A., who has said there is no truth in it, and that the B.D.A., who have their difficulties as anybody else has, has no intention whatever of closing down.

The manufacture of worsted pieces has become very active and fancy worsted spinners have been running full time. The winter trade of the heavy woollen district is nearing completion, and repeat orders are not of considerable bulk. The blanket mills continue to be fairly well employed. Paper mills catering for industrial and trade requirements are experiencing a dearth of orders. One reason would appear to be the holding off on the part of merchants in consequence of a strike increase of about £2 per ton. Present production is going mainly to swell the makers' stocks.

Considerable concern is being exercised by the paper makers towards the enactment of the Sale of Food (Weights and Measures) Bill, enforcing net weights in the sales of food. They are offering opposition. In the event of its becoming law, it is expected to have an adverse effect on paper consumption, and consequently on dyestuff consumption. Standardisation of paper wrappings has been recommended, and

alternatively a maximum weight of wrapping. A paper maker points out that enforcement of net weights would lead to the use of a sugar bag one tenth the weight of that at present used. This in turn would lead to a corresponding decrease in consumption of methyl violet and magenta.

In consequence of the continued inactivity of the British coke ovens pure benzene and pure toluene continue to be imported from the Continent. Limited supplies of xylene of various qualities and of inferior quality motor benzol are available from the same source. Prices of pure benzene range about 3s. per gallon at English port. Aniline oil and salt are quoted at 9½d. per lb. delivered and nitrobenzene at 7d.; benzidine base, delivered, on basis of 100 per cent., 3s. 1d.; creosote, 7½d.; beta naphthol, 1s. 0½d.; pure xylene, 4s. per gallon, and pure toluene, 2s. 6d.

Midlands

Most dyers in the Midlands are suffering from at least two complaints—dear coal and small hand-to-mouth orders; many of them think the end of the coal dispute would to some extent cure both.

Dyestuffs manufacturers and merchants are still badly hit by the continued demand for pale shades.

Wool spinners are working rather more than half time.

Woollen hosiery dyers are very quiet. This section normally works at high pressure during the autumn. There is a half-hearted demand for woollen fabric, mainly for sports wear.

Artificial silk hosiery is no worse than a month ago, and several inquiries for export have been received; fine weather has helped to stimulate the sale of artificial silk fabric for jumpers and underwear.

Real silk hose cannot yet be regarded as an important branch of the industry, but many predict that it will grow. Several houses are now turning out satisfactory goods.

Cotton hose are not selling. Cotton fabric for football jerseys is in moderate demand, and a few orders for fleeced cotton fabric for cheap underwear have been secured.

Tanners of chrome leather are about the same as a month ago and still short of orders. Upholstery leathers as well as leathers for motor clothing are selling fairly well, and there are inquiries for coloured glazed kid.

Prices for dyestuffs are practically unchanged; aniline oil is scarcer and dearer.

British Dyestuffs Corporation, Ltd., have converted their Leicester branch into an agency and have appointed Mr. W. Taylor, their late branch manager, as sole agent for Leicester and the Midlands.

Scotland

The dyestuff market has not experienced any appreciable change during the past month. This has been on the whole less scrappy than the previous one, and for it the absence of holidays is responsible. Inquiries show a growing interest in the use of faster colours on silk, and there is no doubt that much more can be done with this material than is generally realised, although for some of the uses to which silk is put really permanent colours will never be necessary.

The coming establishment of new silk works in Kirkcudbright is confirmed, and the company is to be known as the Scottish Artificial Silk, Ltd. Its progress will be watched with great interest in Scotland. The spinning, however, is to be done in Cheshire.

Dyers have been fairly busy, especially in the south, with the woollen and hosiery lines, which at present have really to congratulate themselves on a very satisfactory state of affairs. For this, foreign orders are partially responsible, but if business is nearly normal, no effort has been spared in making it so.

The new season's shades come up for criticism about this time. What would specially interest dye makers and dyers, however, would be talk of the adoption of very much deeper shades.

In spite of the effort which has been made to keep business levels as near to normal as circumstances will allow, there is no doubt that serious losses, not obvious on the surface, have been encountered, which may neutralise any good results for many months to come.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

"I.C.I."

THE event of the month has been the great chemical fusion, resulting in the formation of Imperial Chemical Industries, Ltd. From the present point of view, the main interest lies in the inclusion of the British Dyestuffs Corporation, with, of course, its associated company, Scottish Dyes, Ltd. This step seems at once to guarantee the future of the British dyestuffs industry in the national sense, and to put an end to the troublesome controversy as to the policy and the future of the Corporation. The negotiations have been conducted with great privacy, and those responsible may be congratulated on the business-like way in which the huge transaction has been completed. When we first announced some months ago the policy of concentration and economies decided on by the B.D.C., the ordinary shares were about 5s.; during the boom they rose to 17s. 6d., and so good is the opinion held of future prospects on the new basis that they remain about 17s. The effect of the combine on the smaller independent dyestuff makers is a matter that is being much discussed, but the general opinion is that it may be less harmful than was at first feared. The more immediate anxiety is the coal situation, which persistently disappoints the expectation of a settlement. Whatever the influences against peace, the matter, however, is slowly settling itself by the gradual return of the miners. But a definite settlement would be very welcome as marking the official turning point.

German Opinion

It is interesting to notice the expression of German feeling in the matter of the "I.C.I." The current issue of the *Deutsche Färber Zeitung*, the organ of the dyer and calico printer, considers the question almost entirely from the viewpoint of its influence on an understanding with German interests. Rather than resenting the formation of a potential rival to the I.G., the tone of the article suggests that the welding of the British industry into one large company will provide a body much more capable than its constituent units of making an agreement with the corresponding I.G., and much more likely to do so. It points out as significant that both Sir Max Muspratt and Lord Ashfield are in sympathy with such an arrangement, while Nobels are already in close agreement with various interests in Germany.

New Colours

PAPER SCARLET 9778K is a recent addition to the B.D.C. range of colours for the paper trade. In addition to good covering power and leaving good backwaters, it possesses the important advantage of cheapness. It is chiefly of interest for cover papers and wallpapers, where cheapness combined with good fastness properties are essential features. The samples of 1 per cent. and 3 per cent. Paper Scarlet on unbleached sulphite are good full tones.

From Scottish Dyes, Ltd., we have received an extended shade card of their well-known Caledon vat colours, containing about half-a-dozen more colours than those issued at the end of last year. The card shows 32 colours (each in two and ten per cent. shades) of the Caledon range applied on mercerised cotton piece goods, for which they are principally used, although they are also employed for both

natural and artificial silk and for linen. The range includes several examples of the yellows, oranges, reds, violets, purples, blues, greens, browns, and blacks. The dyeings are all of single strength pastes, but all the Caledon colours can be obtained as double strength pastes and also as triple strength powders.

Dyestuff Licences for October

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during October has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee: The total number of applications received during the month was 753, of which 692 were from merchants or importers. To these should be added eight cases outstanding on September 30, making a total for the month of 761. These were dealt with as follows:—Granted, 659 (of which 597 were dealt with within seven days of receipt); referred to British makers of similar products, 77 (of which 67 were dealt with within seven days of receipt); referred to Reparation supplies available, ten (all of which were dealt with within two days of receipt); outstanding on October 30, 1926, 15. Of the total of 761 applications received, 674, or 89 per cent. were dealt with within seven days of receipt.

Japanese Government and the I.G.

IT is reported that as a result of lengthy negotiations an agreement has been reached and now awaits ratification between the Imperial Government of Japan and the I.G. Farbenindustrie. The Japanese Government aims at the protection of the recently established native dyestuff industry, and by the terms of the agreement certain dyes will no longer be imported into Japan. The dyes on the list for total prohibition comprise a considerable range of colours; they include Victoria Blue, Safranine, Auramine, Bismarck Brown, Rhodamine B and C among the basic colours; Acid Black, Acid Scarlet, Acid Brown, among the acid colours; many substantive cotton colours, including Congo Red (various brands), Direct Fast Red, Direct Black B, Direct Orange R, Direct Black BH, Direct Blue 6B, Direct Scarlet; and several sulphur colours, including violet, yellow, brown, and black colours.

The projected agreement is meeting with considerable opposition in Japan. The dye consumers object to it, because they foresee a rise in price of the protected dyestuffs and consequent possible loss of trade. The dyemakers themselves object to it because they consider it much too restricted in scope, and likely to result in the limiting of Japanese dyestuff manufactures to the prohibited dyes, and consequent hindering of further developments; they call for the inclusion of many more colours on the prohibited list than those named. It will be interesting to watch the effect of this measure of commercial protection, and to compare it with the results of our own Dyestuff Act.

British Dyes in Australia

IN our Dyestuffs Monthly Supplement of July 10 we published an article from an Australian source in which the embargo on foreign dyestuffs was strongly defended and was said to be working satisfactorily. This view is vigorously contested in a communication we have received from Canterbury, New South Wales, signed by H.V. Bettley-Cooke, A.A.C.I., and R. J. Fielding (late of L. B. Holliday and Co.). "Our attention," they write, "has been called to an article

appearing in your paper, which is not correct in many instances and seems to give you a wrong idea of the real state of affairs here. We, who are both chemists, have been between us engaged in the manufacture of dyes, in the use of dyes both for textile and non-textile purposes, and in selling English, American, and German dyes, so that we can speak with some knowledge of the position, and at the same time we are both British."

Are Australian Users Satisfied?

"THE statement," our correspondents continue, "that the Australian users are satisfied with English dyes is not correct. That they are forced to use English dyes may be nearer the mark. The importation of dyes is controlled by permits, only those dyes which are not made in England being allowed in. The result is that dyes like nigrosine, common cotton blacks, acid blacks (ordinary), Bismarck brown, etc., which are made in England, are not allowed in, but where dyes are required for special purposes or must possess certain degrees of fastness, then the English dyes are out of it. This is due to many causes, but chiefly due to two facts: (1) that they cannot make it, or (2) that their salesmen do not know how to sell it, being only salesmen and not having any knowledge of the dye they are trying to sell. The agitation for the removal of the embargo comes from the users of dyes, who want all the assistance the dye makers can give them; they also want to be able to get the right dyes they need, without having to do a lot of experimenting themselves.

A Typical Case

"WE will give a case that happened to one of us. He obtained an acid brown from an English firm, which was fairly good. This acid brown had to have certain degrees of fastness. When he had nearly used it, he ordered a second lot, but was told they had given up making it, but sent him half-a-dozen similar browns to try, not one of which was any good, although he had taken the trouble to let the manufacturers know for what purpose he wanted it. Eventually he got in touch with Bayers and got what he wanted, without having to waste time trying a lot of unsuitable dyes.

The Case of New Zealand

"YOUR correspondent does not mention New Zealand. New Zealand admits German dyes without a permit, and there the English dyes are losing ground. We believe that the same applies to Canada. In China, the Germans have regained nearly all the ground they have lost. Why should they be able to do this, if the English dyes are as good as the German? We believe, from what we have seen, that the American dyes are, generally speaking, better than the English. We think it would be hard to find a big manufacturer here who uses dyes, who does not use German dyes. One question will decide who is right: If the English firms making dyes are so satisfied that the quality of their dyes is correct, their fastness suitable for the dyers' demand, their salesmanship quite correct and sufficient, why is an embargo wanted? The British dyes pay no duty, the German dyes 10 per cent.

The Question of Price

"DEALING with another point—price; why are the English dyes dearer than the German? Because the Germans obtain a larger yield of dye from their raw material—that is one of the biggest factors in the cost; and another is using all their waste products. Very little in Germany is thrown away, but in England a good deal is thrown away. In certain districts in England, one can see "mountains" of waste chrome from the dye manufacturers. Your correspondent speaks about the English manufacturers looking after Australia while the war was on. They shipped

a lot of rubbish out here, which was well adulterated with salt. We know that one ton of dye often became four or 5 tons before it left the factory. We have ourselves often examined samples which were as low as 20 per cent. of the usual standard, and 40–50 per cent. was quite common.

Not Pro-German

"IN conclusion, we would point out that this letter is written without any suggestion or advice from the German dye combine or their agents, but only to correct a wrong impression which is created by the article, which seems to have been written by a representative of one of the British dye firms, who is endeavouring to boost his own article, because, if he does not, no one else will."

We give these comments, although they are pretty strong, because the communication seems *bona fide*, and because it is well for British makers to know exactly what they are up against in Colonial markets. Possibly, by our next issue, we may receive from British makers a few notes in reply to this sweeping indictment.

Ink Manufacture

THERE has appeared the third revised and enlarged English Edition of *Ink Manufacture, Including Writing, Copying, Lithographic, Marking, Stamping, Typewriter and Laundry Inks*, by Sigmund Lehner, revised by C. Ainsworth Mitchell, M.A., F.I.C. (London: Scott, Greenwood and Son., Pp. 212. 7s. 6d.). There are discussions of the following subjects among others: varieties of ink, writing inks; raw materials of tannin inks and the chemical constitution of the latter; recipes for tannin and ferrous sulphate inks; ferric inks; blue-black and alizarine inks (the latter, incidentally, very often containing no alizarine); extract inks; logwood tannin inks; copying inks; coal tar dyes as writing inks; hektographs and hektograph inks; changes in ink and the restoration of faded writing; coloured inks; metallic inks; Indian ink; lithographic inks and pencils; indelible and other ink pencils; marking inks; stencil inks; ink specialities, etc.

Dyestuffs for Ink

IN regard to the use of synthetic dyestuffs for the preparation of inks some interesting points may be noted: "Inks made from coal-tar dyes have not altogether displaced improved iron-gall inks, for these have a number of extremely valuable and important properties, the most important of which is that they produce very permanent written characters." Among the dyes (apart from the natural colouring matters) which are used in the preparation of inks may be mentioned indigo; and for brightly coloured inks, Eosine Extra AG, Eosin Yellow S, Rhodamine O and B, Fuchsine Extra Yellow, New Fuchsine, Methyl Violet, Malachite Green, Brilliant Green, Acid Green M, Carbon Black O, etc., and Nigrosine, among others. "No coloured ink, it may be observed, except perhaps real indigo carmine and some of the more recently discovered dyes, can compete with the black inks as far as durability is concerned. . . . The requirements of coal-tar dyes for ink making are that they should yield relatively permanent writing and be neither strongly acid nor strongly alkaline; obviously they must also be soluble in water or in alcohol." The following dyes are mentioned as typical of those answering these requirements (for coloured inks): Eosine, Erythrosine, Phloxine, Cyanosine, Fuchsine, and Rubramine for red; Acridine Orange R for orange; Malachite Green, Iodine Green, and Aniline Green for green; Methylene Blue, Patent Blue, Soluble Blue, Induline, and Paraphenylene Blue for blue; Methyl Violet and Crystal Violet for violet.

The book is of convenient size, and contains many recipes, the author claiming that he has personally tested every one of them.

Progress in Textile Bleaching and Dyeing

A Review of Some Recent Developments

By A. J. Hall, B.Sc., F.I.C.

Radical changes have occurred in the dyeing and textile industries since the war. The buying public has developed a taste for fabrics of ever brighter colours blended with high or subdued lustre and delicacy of handle, and this has been met by dyers and textile designers, utilising artificial silks, new dyes and dyeing methods. These changes are described in the following record of progress.

THE increasing use of artificial silks is the most important post-war development in the textile industry. In 1913, the production of artificial silk was about 26,000,000 lb. and during the present year the total production is expected to reach nearly 200,000,000 lb., the greater part of this entering into the composition of wearable fabrics of one kind or other. Formerly, a very large proportion of artificial silk was used for hosiery; now this proportion has diminished by reason of the fact that textile designers have realised the considerable advantages which result from the use of artificial silks in fabrics, particularly cotton piece goods. All these changes have had their effect on bleachers, dyers, printers and dye manufacturers.

Immediately before and after the war, in the greater number of dyeing works, artificial silks were practically unknown. Now almost all dyers have broadened their outlook; they recognise the distinct difference between cellulose (Chardonnet, cuprammonium and viscose) silks and cellulose ester silk (cellulose acetate) and the relationship between these silks and cotton. New dyes and dyeing methods have in consequence been devised and brought into use.

Several problems have arisen in connection with the dyeing of woven and knitted goods containing artificial silk. In the first place the view, generally held, that the dyeing properties of artificial silk were similar to those of mercerised cotton proved fallacious. Artificial silk has dyeing properties distinctly its own, and these became recognised when early dyeing methods resulted in streaky and "barred" dyed materials. In many instances, fabrics, containing an artificial silk weft which appeared perfectly satisfactory in the grey state, appeared, after dyeing, to change in shade with the cop changes. Similarly in knitted fabrics, barred and streaky effects (the bars or streaks being lighter or darker or of a different tone of shade than the remainder of the material) could be traced to the obviously different dyeing properties of the different bobbins of silk used in knitting the fabric. From these defects it soon became recognised that artificial silk was not a uniform product, and that the artificial silk yarn produced by any manufacturer could usually be grouped into three classes according as it dyed to a light, moderate or heavy shade when dyed together in the same dye liquor. These uneven grades of silk were formerly the source of much trouble to dyers.

Even and Uneven Dyeing

In spite of the constant efforts of artificial silk manufacturers uneven grades of silk are ever with us; it is the methods of dyeing which have been improved. From the work of Wilson and Imison (*J. Soc. Chem. Ind.*, 1920, 322) it was recognised that most direct cotton dyes could be divided into two classes according as they yielded even or uneven shades on uneven grades of silk. Generally, dyes of low molecular weight were found to be even-dyeing while those of high molecular weight were uneven dyeing. Examples of this are Chlorazol Fast Pink BK, mol. wt. 944 (uneven-dyeing), Chlorazol Sky Blue FF, mol. wt. 992 (uneven dyeing), Diamine Green B, mol. wt. 812 (moderately even dyeing), Rosophenine 10B, mol. wt. 600 (even dyeing) and Indoine Blue, mol. wt. 521 (even-dyeing). Subsequently Whittaker (*M.G. Artificial Silk Supplement*, March 5, 1925, page 31) has tested out a very large number of dyes of all classes and assigned to each dye a number indicating its even or uneven dyeing properties; dyes numbered 6-13 are uneven while dyes numbered 17-23 are even dyeing.

To-day, dyers of artificial silk materials should always use even dyeing dyestuffs whenever possible and in this way unevenly dyed material becomes exceptional rather than the rule. It is found that even dyes are available for all shades except blue and green; even dyeing dyes of these two colours have yet to be found—a task for the dye manufacturers.

Now of course, every dye maker is familiar with uneven grades of artificial silk and each maker usefully advertises its range of

even-dyeing colours. Yet it was interesting to observe how slow most dye manufacturers were to grasp the problem confronting the early dyers of artificial silks. At that time it was not uncommon for dyestuff travellers and representatives to increase the dyer's difficulties by crowding on to him all types of dyes which were claimed to be even dyeing simply because they were easily water soluble or because they yielded even shades on other fibres.

Another difficulty was concerned with the dyeing of union materials containing cotton and cellulose artificial silks. When such materials were dyed by the ordinary methods, using direct cotton dyes, it was found that the silk dyed to a much heavier shade than the cotton. This effect produced particularly displeasing results in figured fabrics, especially those irregularly woven; the difference in shade between the two fibres produced the appearance of streaks. Moreover, the effect was pronounced whether the fabric was perfectly or imperfectly bleached and prepared before dyeing. Neither was the effect diminished by dyeing at boiling temperatures. Ultimately, the difficulty was overcome when it was discovered that the affinity of artificial silk for a direct cotton dye diminishes more rapidly with decrease of temperature than does that of cotton. The solution of the problem therefore consisted of dyeing the union material in a soap bath at a low temperature.

Dyeing of Cellulose Acetate Silks

New possibilities and difficulties in dyeing arose with the introduction of cellulose acetate silks. These being esters of cellulose had no affinity for direct cotton dyes, but had a moderate but not very useful affinity for basic dyes and no affinity for sulphur dyes. Further, owing to the ease with which it hydrolysed, cellulose acetate silk could not be treated with alkaline liquors containing the carbonates or hydroxides of alkali-metals, although fortunately ammonia can be used without resulting in deterioration. After a period of considerable difficulty suitable dyes for cellulose acetate silk were produced, it being then unnecessary to hydrolyse the silk before dyeing. The Celatene range of dyes was introduced as a result of the observation that many intermediates for vat dyes were capable of dyeing cellulose acetate silk directly from aqueous suspension, and the S.R.A. dyes followed when it was found that colloidal solutions (Turkey red oil is largely employed as a protective colloid) of many insoluble azo and other dyes were suitable for dyeing this type of silk. Generally, development of dyes for cellulose acetate silk has followed the theory that dyeing consists of the solution of the dye within the silk—the solution of one solid in another. This theory is very generally supported and many workers have been able to show that the dyeing of cellulose acetate proceeds according to Henry's law. For most purposes there is now an adequate range of cellulose acetate dyestuffs.

Cellulose acetate silk finds considerable use as one component of union fabrics, chiefly those consisting of cotton and cellulose acetate silk. Union materials containing cellulose acetate silk and wool are not so much favoured possibly because it can be replaced by the cheaper and more serviceable cellulose silks. Cotton fabrics containing cellulose acetate silk stripes and figured effects are now in considerable demand, the two fibres being dyed in different colours. Unfortunately, such materials cannot be bleached by the usual methods before dyeing, since kieren processes hydrolyse the cellulose acetate silk. A compromise method is therefore adopted. The size present in the cotton yarn is removed by treatment with an enzyme such as Diastofor or Novo Ferasol, and the remaining impurities are removed by scouring with a soap solution containing ammonia at a moderate temperature—not exceeding 75°C. It has always to be remembered that cellulose acetate silk yarn immersed for a few minutes in boiling water becomes woolly and suffers a loss of lustre. After scouring, the fabric may be bleached in the usual manner. In the case of knitted

goods, scouring and bleaching may frequently be effected simultaneously at a moderate temperature by using a soap liquor to which sodium hypochlorite has been added. The white thus obtained on the cotton cannot be so permanent as that usually produced by kiering, but at present it is the best that can be obtained under the peculiar circumstances prevailing.

The peculiar properties of cellulose acetate silk by which it hydrolyses on treatment with weak alkalis and deteriorates in boiling liquors are always a source of annoyance to dyers. The effect of boiling liquors is of especial importance since wool is usually dyed at boiling temperature. There is thus a difficulty in dyeing cellulose acetate silk and wool union materials. The writer's discovery (E.P. 246, 879) that cellulose acetate silk could be boiled for very prolonged periods in about 10 per cent. solutions of inorganic salts such as sodium chloride, without the slightest deterioration, is of considerable importance since it now allows the dyeing of wool and cellulose acetate silk union materials at high temperatures.

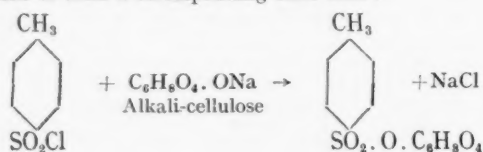
Since cotton itself is a somewhat dull and harsh fibre it is but natural to expect a desire to produce mercerised cotton materials containing cellulose or cellulose acetate silk effects; mercerisation certainly improves the lustre and handle of cotton. Marshall (E.P. 210, 484) early discovered that, contrary to expectations, cellulose acetate silk could pass through the usual mercerising process provided that the temperature of the mercerising liquor was maintained fairly low (not above 20° C) and that the process was carried out rapidly. This discovery has had important results, for there is now a good demand for mercerised cotton fabrics containing cellulose acetate silk stripes or other effects and dyed in two colours. On the other hand, the mercerisation of cotton yarns and particularly cotton fabrics containing cellulose silk has not developed so satisfactorily. This is because viscose silk is very readily penetrated by caustic alkali solutions, their effect being to dissolve a part of the silk and to diminish its lustre and give it a harsh handle. Generally, it is not known how these disadvantages may be avoided but in one or two instances satisfactory large scale mercerisation of such materials is actually being carried out by secret processes. These will probably ultimately be made known.

One point of interest to both dyers and dye manufacturers concerns the dyeing of cotton and cellulose acetate silk materials in which the cotton is left white and only the silk dyed. Although most dyes now in use for cellulose acetate silk have little affinity for cotton, even but a slight tinting of the cotton is capable of spoiling a white ground in the type of fabric here referred to. It is up to dye makers to produce dyes for cellulose acetate silk which have no affinity at all for cotton; there is quite a need for such dyes.

Immunisation of Cotton

Cellulose acetate silks undoubtedly owe practically all their importance to the fact that they allow the easy production of two colour dyeing of piece goods. The demand for such silks would be negligible were it not for these special dyeing properties; their poor resistance to alkalis and boiling water place them at a disadvantage as regards cellulose silks; hence the efforts to produce a modified cotton having substantially the same dyeing properties as cellulose acetate silk, but without its disadvantages. These efforts have met with considerable success and "immunised cotton" is now a commercial fibre. It is now possible to send ordinary cotton yarn or loose fibre to the Sandos Chemical Co. (E.P. 233,704) for immunisation, so that on return it has no affinity for direct cotton dyes, but has dyeing properties similar to that of cellulose acetate silk. Such immune cotton has a full handle but lacks the lustre of the artificial silks.

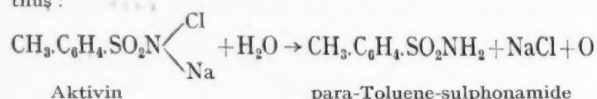
The immunisation of cotton is effected by treating it with caustic soda and para-toluene-sulphochloride in the presence of an inert solvent such as alcohol. In this manner, the alkali-cellulose first formed reacts with the para-toluene-sulphochloride to form a corresponding ester thus:



In point of fact the reaction does not reach completion in the large scale process and neither does it proceed uniformly throughout each fibre. It is found that the immunised cotton contains some 8-10 molecules of para-toluene sulpho residue per 1 molecule of cellulose (C₆H₁₀O₅) and that the outside of each fibre is esterified more completely than the inner portions. An immunised cotton fibre is similar in appearance to a mercerised fibre, having become rod-like and lost its lumen; during immunisation, cotton yarn gains up to 12 per cent. in weight.

At present immunised cotton is somewhat expensive to produce, but it has the great advantage that it can be treated with boiling aqueous liquors and with alkalis of the usual scouring strength without deterioration. Cotton fabrics containing immunised cotton may be singed, mercerised, bleached, and handled fairly roughly, the immunised cotton, as distinct from cellulose acetate silks, being resistant to these treatments.

Para-toluene-sulphochloride appears destined to play an important part in textile treatment, for recently a useful bleaching agent known as Aktivin and related to this substance has been introduced. Aktivin is the sodium salt of para-toluene-sulphochloramide, sold as a pure white powder, which liberates active oxygen when heated in aqueous solution with a reducing agent such as impure textile material, thus:



Aktivin differs from the usual well-known bleaching agents of the peroxide type in that it is very stable even in hot aqueous solutions. Bleaching solutions of Aktivin can actually be used in a standing bath provided that they are maintained slightly alkaline and not acidic. Aktivin is not only a bleaching agent, but a solubilising agent for starches. It can be used as a desizing agent for textile materials or for preparing starch pastes. When a mixture of starch and water containing about 1 per cent. of Aktivin (calculated on the weight of starch) is boiled for a few minutes, the starch becomes permanently liquefied and the product having a high viscosity is suitable for weighting or filling textile fabrics or for sizing warp yarns.

Wetting-Out Agents

No one connected with the textile industry can have failed to notice the enormous number of wetting-out agents which have been introduced during the past three years. With the exception of artificial silks, all natural textile fibres are more or less waterproof before bleaching. Hence before dyeing or other treatment such materials must be thoroughly or uniformly wetted-out; materials unevenly wetted become, subsequently, unevenly treated and patchy. Further, natural fibres resist penetration by liquors used for their treatment and thereby tend to diminish the efficiency of the treatment. This latter disadvantage is clearly shown in the poor results obtained by mercerising cotton fabrics in the grey state. Now, however, the treatment of natural fibres may be made much more satisfactory by the addition of suitable substances to the treating liquor—substances which are capable of reducing its surface tension.

The first wetting-out agents introduced contained Turkey red oil and an organic base (e.g., pyridine) or organic solvent, but since then it has been discovered that certain aromatic sulphonic acids are able to reduce the surface tension of water very considerably. Many of the more recent wetting-out agents therefore consist of an aromatic sulphonic acid or its salt and one or more suitable organic solvents such as tetrachlorethane and carbon tetrachloride. Hydrogenised derivatives of naphthalene have also been utilised for these purposes. To-day, all kinds of substances are being marketed for the purpose of assisting scouring, bleaching, mercerising, dyeing, and carbonising textile materials. These substances most certainly assist penetration and some, according to their composition, promote the removal of greasy and fatty impurities. Bleachers and dyers who ignore these assistants are missing valuable opportunities to improve their methods of textile treatment.

Several interesting and useful developments have occurred in connection with vat and developed dyestuffs.

Just before the war, dyers of Para Red, Naphthylamine Claret and such shades were introduced to Naphthol AS as a substitute for β -naphthol. Not only did this substitute yield brilliant and fast shades of Para Red, but it had a definite affinity for cotton so that the well-known difficulties of preparing cotton yarn or fabric with β -naphthol, before coupling with the diazotised paranitraniline, could be avoided. Naphthol AS is the anilide of β -hydroxynaphthoic acid. Subsequently, other derivatives of β -hydroxynaphthoic acid have been investigated with the result that nearly a dozen such compounds have been found serviceable. A number of suitable bases have also been developed so that now a very useful range of naphthols and bases are available, this range now comprising orange, red, purple, blue, and black shades. In general, the shades of this series, obtained by preparing cotton with a suitable Naphthol AS compound and afterwards coupling it with a selected diazotised base, are very fast to all influences. Further, they are cheap and now enable dyers to produce materials dyed in shades of guaranteed fastness independently of vat dyestuffs. The Naphthol AS dyes are the most important dyes discovered since the war.

The most recently discovered dyes are those termed Indigosol

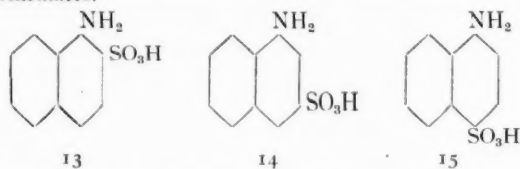
and Soledon colours. These are water-soluble salts of sulphuric acid esters of indigoid and anthraquinone vat dyes. They are comparatively stable under ordinary conditions of dyeing, but may be readily converted to the fully oxidised insoluble form by mild oxidation by means of a bichromate or nitrous acid. The Indigosol dyes have but little affinity for cotton and must be applied by padding methods, whereas the Soledon dyes have a definite affinity for cotton and may be dyed as direct cotton dyes. After application to cotton, both types of dyes are developed to their permanent fully oxidised shade by treatment with nitrous acid (sodium nitrite and sulphuric acid). These two ranges of dyes include but a few colours, but they are useful in so far as they do not require an alkaline dye liquor and may be applied to wool and silk in much the same manner as acid dyes. However, before they can become popular among dyers they must be produced more cheaply.

Such, then, are the most important advances made in the dyeing and other treatment of textile materials during the past six years. What of the future? Only one thing is certain—that artificial silks will enter more and more largely into textile materials, thus rendering the tasks of the dyer more varied and more interesting.

Basic Intermediates for Dyestuffs: No. IV.—The Monosulphonic Acids of α -Naphthylamine

By "Consultant"

THE sulphonic acids of the two naphthylamines constitute a whole family of intermediates whose importance for the manufacture of dyestuffs of all classes cannot be exaggerated. Of the seven possible monosulphonic acids of α -naphthylamine, all with the exception of the 1:3 acid, are in common use for various purposes. Some, such as 1:6, 1:7 and 1:4 acids, can be used directly for the production of dyes, as first or end components; whilst others, such as 1:8 acid, are of no use at all as components and serve only for the preparation of other intermediates.



1-Naphthylamine-2-sulphonic acid. (13.)

This acid can be used for the preparation of various azo-dyes and finds use almost exclusively in the preparation of Fast Acid Blue B. Direct sulphonation of naphthylamine is incapable of giving any appreciable yield of this acid, so that an indirect method of preparation has to be resorted to. The reaction involved in the preparation of 1:2 acid is the rearrangement of 1:4 acid (naphthionic acid) into 1:2 acid by heating with naphthalene to a high temperature. Technically the operations are comparatively simple, and are carried out as follows: The sodium salt of naphthionic acid ($\frac{1}{2}$ cwt.) is dried and pulverised to dust size, and sifted slowly into an oil-heated pot which contains melted naphthalene ($\frac{1}{4}$ cwt.). The cover conveying a powerful stirrer and a reflux condenser is placed into position, stirring is started, and the naphthalene is slowly raised to its boiling point (218°C). The condenser is provided with water at 90°C . in order that clogging with solidified naphthalene may be avoided. The heating is maintained for three hours, after which the batch is cooled to about 100°C ., hot water added, and the residual naphthalene blown off with steam. The residual solution is diluted to about 30 gallons and neutralised with soda ash. The filtered liquid is salted when comparatively pure 1-naphthylamine-2-sulphonic acid separates out and can be pressed to a paste.

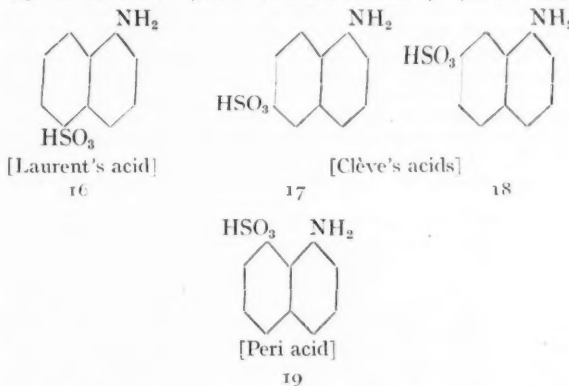
1-Naphthylamine-4-sulphonic acid. (Naphthionic acid.) (14.)

Naphthionic acid is one of the ideal intermediates for the preparation of azo dyes, being useful either as a first or as an end component. Used as a first component with naphthols

or their sulphonic acids it gives a good series of Fast Reds, particularly useful for wool; whilst as an end component in conjunction with diazotised benzidines, toluidines, etc., it gives the Congo Reds and Benzopurpurins, which although bright are very sensitive to acids. Fast Brown N, Diamond Blue, Crocein Scarlet, Congo Corinth G, Dianol Red, etc., are examples of dyes from naphthionic acid.

Naphthionic acid is prepared by the direct sulphonation of naphthylamine. The amine (1 cwt.) is melted at 60°C . in an oil jacketed pot, and 94 per cent. sulphuric acid (82 lb.) is slowly run in. The batch is then slowly heated to 170 – 180°C ., at which point oxalic acid (about 5 lb.) is added. The addition of oxalic acid gives a pasty porous mass which is immediately run out on to lead plates, over which it is spread in a thin layer. These plates are then heated at the same temperature (170 – 180°C .) in a vacuum oven for five hours, during which water is removed and sulphonation completed. The cooled residue is powdered, boiled with water and the solution neutralised with milk of lime. The clear filtrates containing the calcium salt of naphthionic acid is acidified with hydrochloric acid and stirred for six hours at 20°C ., when the naphthionic acid separates out in needles and can be filtered off and pressed. The yield is about 144 lb. calculated as 100 per cent. acid.

1:5 and 1:8 acids. (Laurent's and Peri acids.) (16 and 19.)



As an end component in azo-dye manufacture 1-naphthylamine-5-sulphonic acid (Laurent's acid) (16) finds considerable use, especially in the production of Brilliant Fast Red,

Congo Brown R, Benzopurpurin 6B, Diazo Black B, etc. Peri acid (1-naphthylamine-8-sulphonic acid) (19), however, is almost solely used for the production of 1-naphthylamine-4:8-disulphonic acid. Both Peri and Laurent's acids are produced together by the nitration of naphthalene-1-sulphonic acids, and reduction of the nitro compounds so produced.

Naphthalene (1 cwt.) is finely powdered and stirred into 93 per cent. sulphuric acid (2 cwt.), the temperature being allowed to rise no higher than 40° C. Some caution is necessary here since the sulphonic acid will, in the absence of nuclei, separate out in the form of a liquid, which may later solidify suddenly, stopping the stirrer and rendering extraction difficult. If, however, as is usually done, the batch is inoculated with a few crystals from the previous run, the acid will separate slowly and in a crystalline form from the commencement of operations, thus giving an easily stirrable batch. When sulphonation is over, nitration is proceeded with forthwith, additional sulphuric acid being provided if necessary. The nitric acid (90 lb. of 60 per cent. acid) is added during 2½ hours with constant stirring, the temperature being kept within 10-15° C., and stirring is continued for twelve hours, after which the batch is poured into water (100 gallons). The solution, which now contains a mixture of 1:5 and 1:8 nitronaphthalene sulphonic acids, is reduced without the isolation of these compounds. Iron borings (2 cwt.) are added to the solution, which rapidly becomes hot, at such a rate that it remains neutral to Congo paper. The acids are removed from the liquor by means of their ferrous salts. To this end, iron "pin-dust" (35 lb.) is added to the hot liquid, and on cooling the ferrous salts of the acids separate and are filtered off and decomposed with dilute sulphuric acid, when ferrous sulphate passes into solution and the acids themselves are precipitated. The separation of the two acids is conducted in the following way: The paste of acid from the last operation is dissolved in enough hot water and magnesite (35 lb.) added. The solution is filtered from dirt and sufficient salt added to make a 10 per cent. solution. After stirring for several hours the 1:8 acid which separates is filtered off and pressed, and the 1:5 acid precipitated from the residual filtrate by the addition of hydrochloric acid. From 1 cwt. of naphthalene about 88 lb. of Peri acid and 35 lb. of Laurent's acid are obtained.

The Clève's acids. (1-Naphthylamine-6-sulphonic acid and 1-naphthylamine-7-sulphonic acid.) (17 and 18)

Clève's acids have been used for the preparation of blacks such as Columbia and Biebrich Patent Blacks, and also for the preparation of 1:4 naphthylenediamine-6-sulphonic acid. They are manufactured in large quantities by a process similar to that used for the Laurent's and Peri acid, save that the sulphonation is conducted to produce naphthalene-β-sulphonic acid, and that the nitro acids cannot be reduced in acid solution, a neutral liquor being necessary.

Naphthalene (1½ tons) is melted and warmed to 100° C., and sulphuric acid (1½ tons of 94 per cent.) run in with stirring, at a fairly rapid rate. The temperature rises to 160° C., and is maintained there, until sulphonation is completed. The condensers are, as before, supplied with water at 90° C., in order to avoid clogging. After sulphonation, dry steam (dry, to avoid foam) is passed in at 160° C., when excess of naphthalene distils over, and any naphthalene-α-sulphonic acid is hydrolysed to naphthalene, which is removed in the same way. The mixture is then cooled and sufficient sulphuric acid 85 per cent. to give a workable nitration mixture is added (2½ tons). The nitric acid (theoretical) is run in with considerable stirring so that the temperature remains between 10-15° C.

To obtain a neutral solution for reduction, the acids are converted to their magnesium salts. To this end, enough magnesite is added to completely convert the acids to their magnesium salts and the neutralisation is completed with chalk. The filtered liquid, containing the nitro naphthalene sulphonic acid magnesium salts, is filtered, diluted slightly and "activated" iron borings added (3½ tons). The borings are "activated" by etching with dilute acetic acid. When reduction is proceeding the addition of a little magnesite keeps the liquid neutral. The filtered liquid is cooled, stirred and 6 per cent. salt added when the 1:7 acid is precipitated. The 1:6 acid is obtained by acidification of the filtrate.

From the above quantities about 17½ cwt. of 1:7 acid and about one ton of 1:6 acid is obtained.

The Cotton Research Institute Further Points from Dr. Crossley's Report

LAST month some extracts from Dr. Crossley's report on the work of the research staff of the British Cotton Industry Research Association were given in this supplement. Below are given a few further extracts, covering the rest of the report.

Loss of strength.—All forms of chemical attack are accompanied by a loss of tensile strength which runs parallel to a fall in the viscosity of the cotton dissolved in cuprammonium. It has now been shown that for the same fall in viscosity very nearly the same loss of strength occurs, so that the extent of tendering can be predicted and the measurement is, very usefully, independent of mechanical tendering.

Steaming and ageing.—A resistance thermometer has been designed and constructed for the measurement of temperature inside the ager. This has been tested in actual practice, and has been found capable of registering the fluctuations of temperature which occur during the ageing of a succession of pieces, and which at times are so rapid that ordinary thermometers are useless. A study has been made of the distribution of temperature along the ager during the ageing of pieces printed with vat colours, and it has been found that in general there is a maximum temperature about one-third of the way along the ager. Observations taken over the course of a week show that there is a steady rise of temperature during the week, superposed on the normal fluctuations due to differences in successive pieces.

Mercerisation of single hairs.—The investigation of tension effects undergone by single hairs during mercerisation has been carried to a considerable distance by means of the newly designed mercerisation balance. As a result, it is now possible to state with some confidence what is happening in the various portions of the yarn during the various stages of the mercerisation process, and to see how irregularities of mercerisation are produced.

Mercerisation of yarn and lustre results.—An experimental yarn mercerising machine has been installed in the technological laboratory and a study is being made of the effects produced upon cotton yarn by variations in the conditions of treatment during, or prior to, mercerisation. Thus the effect of the residual cotton wax on the properties of the yarn is under thorough investigation, and the appearances resulting from many variations in technique are being examined.

The Lustre of Schreinered fabrics.—The effect of (1) cross sectional shape of line (2) angle of line and (3) wear of shell have been investigated for warp and weft faced sateens and the work is being extended.

Tendering by light.—A more extended examination of the influence of a number of mechanical and chemical factors on the tendering of cotton yarn by light has led to the general conclusion that any treatment which increases the strength of the unexposed material also increases its resistance to light. Bleaching leads to an appreciable loss of strength by singles cotton yarn, and bleached yarn is proportionately more weakened by exposure than is the grey yarn. The susceptibility to tendering of mercerised cotton is apparently much the same as that of unmercerised, while doubled yarns are rather variable in behaviour as compared with singles, though from the point of view of the residual strength of material which has suffered a long exposure one end of doubled yarn is superior to two of the singles.

Testing.—A continuous succession of cases of tendering have been examined in connection with researches on the effects of (a) light, (b) oxycellulose formation, (c) hydrocellulose formation on cotton, and also as a method for diagnosing faults in production. A new model of the ballistic tester has been made by a commercial firm to a design enhancing still further the rapidity of the test. It is hoped that members will now take opportunity of becoming acquainted with this instrument and its possible utility in mill practice.

The need for fabric testing has been met within the limits of available space by a double-range lea tester for which cloth testing accessories have been made. Ballistic tests for cloth have been found sufficiently successful for adoption as a routine method and the results are very regular on narrow strips of plain fabric. Difficulties encountered in previous attempts seem to have arisen more from unsuitable methods than from the nature of the test. Research is proceeding on the optimum dimensions of specimen, the influence of weave and other factors in the regularity of the results.

Dyes and their Application: Recent Technical Progress

By L. J. Hooley

Mordant Azo Colours

ABOUT 20 per cent. of the azo colours come in the chrome class. The majority are monazo dyes, the remainder being disazo, with two or three in the tris- or tetrakis-azo groups, so that they are generally simple in structure. In addition to this 20 per cent. there are, of course, many others which might be used with chrome, but which in practice are not. Many of the azo mordant colours are also used largely as acid colours. These are the ones containing sulphonic acid groups, but where hydroxy or carboxylic acid groups alone are available the use of a mordant is essential. These latter come more into line with the true alizarine mordant colours. Chroming fulfils the purposes both of deepening the shade and increasing the fastness. Where little or no alteration in shade takes place, the chrome is used solely with the object of making the dyeings faster. It is in washing, milling and potting that the effect is most marked. Often the light fastness is enhanced as well, but this is not always so. In a few cases the fastness to stoving becomes slightly less. As well as being deepened, the shade is sometimes also rendered fuller; but almost without exception there is some loss in brightness. A large number of the azo mordant colours are blacks or deep blues, and these form the very important fast azo blacks, and are generally of little technical interest as unchromed acid colours.

The use of azo derivatives with chrome was discovered by Erdmann and Borgmann in 1893, who coupled diazo-ortho phenols with amines and phenols. Some of their products are still on the market under various names, such as the Anthracene and Palatine Chrome Colours. They belong to the ortho hydroxy azo division, which is the most important division of the azo chromes. Other dyes of this type had been discovered earlier; as, for example, the product later known as Anthracene Chrome Black; but the possibility of using them with chrome had not been recognised. The use of the names Alizarine and Anthracene for these colours has nothing to do with structure, but is rather to suggest fastness. Although the *o*-hydroxy azo derivatives are the most important, the presence of a hydroxy group ortho to the diazo linkage is by no means essential, as is sometimes stated. Where, however, the auxochrome is more distant from the azo group, there is often little or no change in shade on chroming. The azo chrome colours are primarily wool colours, but they are also used for silk, and in some cases for dyeing cotton and for calico printing.

Methods of Application

Side by side with the growth of these colours in number there have been important developments in their application. The oldest method consisted in first chroming the wool in one bath and then dyeing the chromed wool in a second bath. This is still the method in greatest favour with conservative dyers. The other two methods are the top or afterchrome, and the metachrome. In this last, chroming and dyeing are carried out together. These later developments make dyeing simpler, quicker and more economical, and the latest types of dyestuffs, which are being made for use in this way, are gradually losing any disadvantages which they have had compared with the old, and are becoming increasingly popular.

In recent years the simplification of the process has been carried a step further, by incorporating the chromium in the dye complex. The dye is then used as an acid or less frequently as a direct dyestuff. Some of them require rather a high concentration of acid in dyeing, which is a slight drawback. In addition to chromium, other metals are incorporated, and in some cases the products receive an additional chroming in the dyeing. The constitution of these metallic compounds is, as in the case of most mordanted colours, largely a matter of conjecture. Some of the most recent of the new products are described below. Typical examples are to be seen in B.P. 253,659. B.A.S.F.

Benzidine + 2 molecules salicylic acid..... — (orange).
4'4' diamino stilbene 2'2' disulphonic acid
+ 2 molecules salicylic acid..... — (orange).
5'5' dihydroxy 2'2' dinaphthyl carbamide 7'7'
disulphonic acid + 2 mols. *p*-amino salicylic
acid..... — (red).

5'5' dihydroxy 2'2' dinaphthylamine 7'7' disulphonic acid + 2 mols. *o*-amino-*p*-sulphosalicylic acid..... — (violet).
Benzidine 2'2' disulphonic acid + 2 mols. 2 (4' hydroxy 3' carboxy phenyl) 5-naphthol-7-sulphonic acid..... — (violet).

The above are all diazo dyes containing two molecules of a simple or substituted salicylic acid, which is one of the most useful intermediates for this purpose.

By treating the dyestuffs with chromium salts, chromium compounds of the dyestuffs may be obtained. These are soluble in water, and may be dyed just like substantive dyes, without any additions to the dyebath other than those normally used in direct dyeing. They can also be applied in the usual manner by adding the chrome to the dyebath instead of combining chromium with the dye molecule.

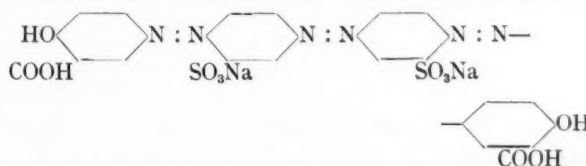
Acetoacetic Acid Derivatives

Esters or arylides of acetoacetic acid may also be used for the production of *o*-hydroxy azo dyes. Thus in B.P. 235,862 (S.C.I.B.) the following are given:

4-nitro-2-amino phenol and ethyl acetoacetate..... (reddish yellow).
6-nitro-2-amino phenol-4-sulphonic acid acetoacetanilide..... (reddish yellow).
4-nitro-2-amino phenol-6-carboxylic acid acetoacetanilide..... (greenish yellow).

These also are combined with chromium and then applied as acid dyes.

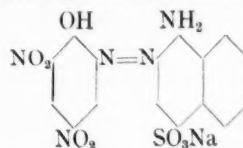
Trisazo dyes of type similar to that shown below are



patented by the S.C.I.B. in B.P. 250,075. These are obtained from *p*-nitro amines by alkaline reduction of the nitro groups. Diazo bodies are obtained, and these then tetrazotised and coupled with two molecules of salicylic acid. The reduction may also be stopped at the azoxy stage, giving disazo dyes instead of trisazo. These may be either used themselves or converted to chromium compounds.

Examples where metals other than chromium are combined with the colour nucleus are seen in B.P. 241,572 and 249,884 (S.C.I.B.). In the first, nitrated diazotised 1-amino-2-naphthol-4-sulphonic acids are coupled with naphthols, and the products then reduced and afterwards treated with zinc in the presence of an alkali. The zinc compounds are salted out, and give direct violet shades on wool. The dyeings may, in addition, be chromed to give blacks. In the second, *o*-hydroxy azo dyes are obtained from a 2-amino-1-oxy naphthalene-8-sulphonic acid, and then combined with copper or chromium. They are used as acid dyes on wool and those containing carboxylic groups for calico printing on a chrome mordant.

Colours from diazotised picramic acid intermediate in complexity between the Chrome Browns and Chrome Patent



Green are converted into soluble chromium azo colours in B.P. 247,556 (S.C.I.B.). They give various shades of green.

The chrome colours obtained in B.P. 226,797 from 3-hydroxy-1'8-naphthalene dicarboxylic acid are extended to the corresponding amine in B.P. 246,394.

The above patents well exemplify the present tendency in dyestuff research to combine fastness with ease of application.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

BUSINESS on the whole remained at the September level and, from the point of view that a further drop was anticipated, this must be regarded as satisfactory.

During the month the estimated yield of the American cotton crop has experienced a further addition, and it now stands at the enormous total of seventeen and a half million bales. There is also a considerable stock left over from last year's crop, and under the circumstances the price of 6½d. for cotton futures cannot be considered low. There is also a high yield of Egyptian cotton, with the result that in the United States of America and Egypt there are under discussion various financial proposals for preventing prices falling to entirely uneconomic levels. Needless to say, Lancashire welcomes what appears to be a stroke of fortune in her favour.

Unfortunately the belief that the coal stoppage would end in October has not been substantiated, nor is the outlook as promising now as it was at the end of September.

The great sensation of the month has been the amalgamation of Brunner Mond, Nobels, United Alkali, and British Dyestuffs. It had been evident for a considerable period that a sympathetic understanding existed among the leaders of chemical industry in this country, but that such a combination could be brought about was not generally anticipated. The combination will now occupy a similar position to that of the leading German and American chemical concerns, in that dyestuffs will only represent one of many activities. It is quite clear that the world movement is towards the stabilising of prices, and on this basis other British dyestuff manufacturers cannot consider that their position has been made worse.

Yorkshire

Monotony of resignation to the ill effects of the coal stoppage on the dyestuff industry intertwined with rumours of the fusion of big interests was characteristic of the first three weeks of October. When the announcement was made that actual negotiations were in progress and subsequently that the Imperial Chemical Industries, Ltd., would be evolved the coal stoppage was forgotten for the moment, and the probable effects of the merger on the outside Yorkshire concerns untiringly discussed. Opinions with regard to dyestuff manufacturers were so varied as to give rise to a "wait and see" attitude, but that dyestuff and chemical merchants were in for a thin time as projected when I.G. Dyestuffs, Ltd., commenced operations appeared to be accepted.

In the heavy woollen district repeat orders for winter clothing are reported to be tardy and overseas trade particularly poor. The heavy expense at which manufacturers are keeping their mills open, consequent upon increased fuel charges, which are treble pre-dispute prices, is rendering it impossible to make a profit. Indeed, many employers would rather close than continue under present conditions, and only a desire to provide work for their employees induces them to keep their machinery moving. There exists, however, a confidence that an early settlement of the dispute would bring about an immediate trade revival.

From Huddersfield there is not much change to report in connection with the various branches of the textile trade. The woollen section is not progressing at all satisfactorily and the worsted section is not much better. There are loud complaints of foreign competition. Despite the adversities expressed in this paragraph, dyers in the district, more particularly those engaged on cotton yarns, are fairly active and dyestuff manufacturers continue to receive orders in sufficient quantity to enable them to operate up to the limits of their coal supplies.

Charleston Dyeworks at Baildon, near Bradford, till recently in the occupation of Wilkinson and Newsholme, Ltd., for about twenty years, were offered for sale by auction and bought by the Bradford Dyers' Association, Ltd., for £13,750. The reason for the sale was the voluntary liquidation of the late occupants.

In the regrettable death of Mr. Percy William Cole the trade has lost a familiar figure. He was the senior partner in the firm of Cole and Wilson, colour and chemical merchants of Hudders-

field, and for a number of years prior to the war, in which he served as a sergeant and was wounded, represented Kalle and Co. in the Huddersfield district.

Dyestuffs do not increase in price; in fact, a reverse tendency has been observed. The markets for crudes and coal-tar intermediates are unaltered.

Henry Ellison, Ltd., of Cleckheaton, announce that, as from October 1, their interests as tar distillers in Yorkshire will be transferred to Yorkshire Tar Distillers, Ltd., and that the business will be carried on under the same management.

Midlands

Since the appearance of the last Dyestuffs Supplement, the new chemical merger has provided a subject for conversation for all those interested in dyewares. Consumers of dyestuffs are, on the whole, in favour of the combine, and regard it as of considerable commercial and national importance. Merchants and agents selling dyestuffs manufactured by firms outside the combine have, however, a good deal of cold water to throw on the scheme, which is perhaps natural.

There is still very little life in the trade amongst dye consumers in this area, although trade in several sections shows signs of improvement.

Wool spinners making suitable yarn for spattees have been able to secure some orders. Pullovers are selling readily, and the cold spell has helped wool spinners generally, but several are still working short time. Woollen half-hose are in rather better request. Artificial silk hosiery is not quite so brisk, and the same may be said of artificial silk fabric. Real silk stockings are selling fairly well, and firms turning out satisfactory goods in cheap and medium priced lines find a ready sale, as most of the stocks imported before the silk tax was imposed are sold. Cotton hose are very slow. Cotton fabric is patchy. Lace curtains dyed with fast vat dyes are selling in small lots.

Heavy chrome leathers are in poor request. Glazed kid in colours are selling moderately well, and blacks are just moving, but there are still heavy stocks of black kid in some warehouses. Glove and hat leathers are quiet.

High priced coal and raw material required by dye manufacturers appear to have had a steadying influence on prices for dyewares, and the only changes to report are slightly lower figures for vat colours and sulphur blacks.

Scotland

The unusually severe weather of October has come as an advantage to the hosiery and garment dyers and manufacturers, although it has not been quite so much appreciated by the other sections. It has accelerated business, which in normal years is not properly felt until November or December. The work on next season's goods is also in full swing, largely with export orders for chevots, tweeds, etc., and in some cases there is not a sufficient number of skilled weavers to go round. Dyers of blues, greys, and drabs are correspondingly fully occupied.

In other branches in Scotland, business continues to get worse; while slightly better in the Paisley district than in Glasgow it is bad in both. Practically all dyers are on short time, and many working only two or three days a week. Dyeing is better than printing, and piece dyeing better than yarn dyeing, but in all these the export trade is at a low level. Dyestuffs sales are down in the same way, the faster dyes standing up better than the others.

At the moment of writing the hopes of a termination to the coal question are higher than at any time since May. Expectations of considerable increase in business once this is over are not expressed so freely as a little time ago, but are still present, and it will be interesting to watch how they are fulfilled.

On the producing side, the item of greatest interest has been the formation of Imperial Chemical Industries. Although rumours had been freely circulating in Glasgow in this connection none of them had suggested a combination of such importance. There is no doubt that the arrangement must ultimately work to the advantage, not only of the chemical industry itself, but of the dyeing industry as well.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

A Dyestuff Works Explosion

It is satisfactory to hear on first-hand authority that the effects of the recent explosion at the Castleford Works of Hickson and Partners, Ltd., are much less serious than was at first reported and that manufacture has not been interrupted to any very serious extent. The actual cause of the explosion will no doubt be the subject of further consideration, for at present the experts are in doubt about it. The suggestion has been made that under certain conditions sodium dinitrophenate may be capable of exploding, though this has not been generally suspected. The case recalls some circumstances of the great Oppau explosion, the cause of which has never been satisfactorily explained. It was always assumed there that ammonium nitrate was a stable substance and that it could be broken up without risk. Before the Oppau explosion, however, ammonium nitrate which had aggregated, exploded while it was being forcibly broken up in railway wagons, and although the cause was never ascertained it was decided at once to discontinue the practice. Investigations by German, British, and American scientists have failed to carry the case much beyond this point. Mishaps of this kind often result in the discovery of new knowledge, and it will be interesting to know if the investigation into sodium dinitrophenate reveals any hitherto unsuspected risk of danger.

B.D.C. Shades for Spring

THE British Dyestuffs Corporation issue a charming range of thirteen fashionable shades for next spring, namely, Picasso, Larkspur, Rubric, Naples, Cocoa, Heather, Lime Green, Lagoon, Pompadour, Sedge, Caramel, Gorse, and Mist. The shades, while of a very delicate nature, have plenty of character and strength, and in each case the proportions of dyes from which the colours are obtained are given. The range is not exhaustive, being intended merely to furnish suggestions, and the Corporation are prepared to give recipes for the matching of any other desired shade on wool or any other material. The dyeing of the colours shown is carried out in the usual way for acid colours, with the addition of 10 per cent. Glauber's salt and 2 per cent. sulphuric acid.

A recent addition to the B.D.C. range of water soluble colours for lake making is Lake Orange O. It possesses a bright fiery orange shade, being distinctly redder than Acid Orange G. Lake Orange O finds its principal use in the production of a brilliant reddish orange lake for paper surfacing and printing ink colours. It is also of value for use in the preparation of imitation red leads. It is soluble in water and gives the best results when converted into a barium lake. A much paler tone is shown on paper treated with 5 parts of lake and 95 parts of China Clay.

Caledon Colours on Silk

WE have received from Scottish Dyes, Ltd., a beautiful collection of their well-known Caledon Colours dyed on natural silk, giving effects singular for their combined softness and brilliance. Altogether 22 distinct colours are shown, and as each colour is illustrated in two different strengths (5 and 20 per cent.) we have in effect a total of 44 shades. The Caledon dyes shown are the following:—Yellow 5G, Yellow 3G, Gold Orange G, Orange RRT, Red 5B, Red-Violet 2RN, Brilliant Purple RR, Brilliant Violet R, Purple R, Dark Blue B, Navy Blue, Blue R,

Blue RR, Blue RC, Blue GCD, Blue GC, Jade Green, Green B, Olive R, Brown B, Brown KT, and Brown R. Some misapprehension has existed at times as to the use of vat colours on natural silk. The patterns here shown have been dyed by almost exactly the same method as that used for cotton, and the results are distinguished for their purity and beauty. The British Silk Association, we understand, have recently carried out work to show that the loss in strength in the case of natural silk is either negligible or at most represent only a few points per cent. So fast are these dyeings that they will withstand a 12-hours' soap boil.

Methods of Dyeing Silk

SILK, it is explained in the notes accompanying the sample, may be dyed with Caledon Colours in a similar manner to cotton or viscose. A little more care is necessary than with cotton, but the harmful tendency of alkali has been exaggerated, and by proper observation of the conditions of dyeing this may be carried out with practically no measurable loss in strength and very little appreciable alteration in appearance or handle. The high intrinsic value of silk makes the use of fast colours especially appropriate, and where fabrics are to be guaranteed they are absolutely necessary. The range of Caledon Colours shown only includes those of the series which are suitable for dyeing silk. Among the colours omitted are Caledon Red BN and Caledon Yellow G; these give poor colour value in deep shades, but they can be thoroughly recommended for pale and medium dyeings. Special attention is drawn to Caledon Yellow 3G, Orange RRT, Red 5B, Brilliant Violet R, Blue RR, Blue GC, and Jade Green.

Degumming

DYEING is most suitably carried out on degummed yarn, as this has more affinity for the colour and the results are slightly faster to washing. Even if the degumming operation is omitted, which is not desirable, some of the gum will come off during dyeing. Degumming should be done just below the boil in a 1 per cent. soap solution for about one hour. Two separate soapings may with advantage be given.

The Caledon colours are not normally considered for dyeing weighted silks, nor are they recommended for this purpose. The methods of dyeing are identical with those used for the Caledon Colours on cotton, but care must be taken that the quantities of caustic soda are properly adhered to. Some dyers prefer to work with longer baths than in the case of cotton and reckon on from 30 to 40 times the weight of the yarn. If the bath is lengthened in this way the caustic soda, sodium hydrosulphite, etc., must be increased in the same ratio. After dyeing, the goods are oxidised in the usual manner, soured, rinsed, and soaped for 5 to 10 minutes in a 1 per cent. soap bath at about 60° C. (140° F.). The dyeings obtained in this way have a fastness to washing quite outside the range of that previously associated with good silk dyeing.

New Geigy Colours

NEW pattern cards issued by J. R. Geigy contain some attractive examples of colours for cotton printing, namely, Chrome Fast Printing Red G and Brilliant Chrome Printing Red B. Both are described as new homogeneous dyestuffs in powder form for cotton printing; printed with acetate of chrome, they yield nice red shades of good fast-

ness properties. They are unsuitable for coloured discharge work, but the dischargeability with hydrosulphite, with tin crystals, or with chlorate is said to be good. The designs, which may be described as rather of the "jazz" type, are quite striking, and the two samples of roller printing work are particularly bright and clear. The international character of the firm's connections is indicated by the fact that the instructions are printed in five languages.

Cost of Dyes in Fabrics

ALTHOUGH we have not yet seen the full text of the U.S.A. Tariff Commission's report on the proportion that the cost of dyestuffs bears to the total cost of finished fabrics, some interesting particulars are already available. The Commission collected data from 32 textile firms, and the following cases indicate the proportion of the cost of the dyes used:—

COTTON.	Cost of Dye in cents
Men's working shirts, indigo dye	0.20
Men's shirts, woven madras, vat dyes	1.00
Men's shirts, sulphur dyes	0.25
Men's shirts, printed with vat dyes	1.25
Men's shirts, basic and chrome colours	0.25
Soldier's khaki suit, sulphur dyes	3.00
WOOLLEN AND WORSTED.	
Men's suit, 14 oz. blue serge worsted	11.00
Police uniform, dyed with indigo and alizarine	18.00
Men's woollen suit, 14 oz., mixed colour	7.00
Men's overcoat, 20 oz., mixed colour	16.00
Women's fancy worsted costume, 10 oz. serge	9.00
Women's fancy worsted costume, silk stripe serge, 10 oz. ..	15.00
Women's overcoat, Bolivia cloth, 20 oz.	28.00
SILK.	
Silk dress, plain silk (9 yards per lb.)	4.00
Silk dress, georgette crepe (18 yards per lb.)	2.00
HAT.	
Men's felt hat	1.25

Cost per Yard

THE cost of the dye naturally varies considerably as between light and dark shades and also in accordance with the weight of fabric to be dyed. Although the average cost per yard may mean very little in the absence of other details, figures have been prepared indicating the general range of cost on a yardage basis. For example, the cost of dye in three cotton piece-dyeing plants for the year 1914 amounted to one-eighth cent per yard. During 1918, a year of peak prices, the same three plants had a cost of one-half cent per yard. Data obtained by the Tariff Commission from three cotton piece-dyeing plants for 1924 and 1925 show the cost of dye per yard of about one-third of a cent. The cost of dye per yard for broad silks for one large plant in 1925 was 1.5 cents per yard as compared with 5 cents during the war period. Four silk piece-dyeing plants showed for 1924 and 1925 an average cost of 0.65 cent per yard for dyes, and three silk printing establishments show for the same period a dye cost per yard of 0.94 cent.

Is Dye Cost a Vital Factor?

It is obvious from the above figures that the cost of the dye used is very small in proportion to the total cost of the finished fabric, and that only in cases where competitive prices are cut to almost atomic proportions could a little variation in dye prices appreciably affect selling prices. In the case, for example, of a khaki suit, where the total dye cost is 3 cents (roughly 1½d.) a reduction of 33½ would effect a total saving of ½d. In the case of a woman's overcoat, apparently the most expensive item in the list, the saving would be 4d., not of course entirely negligible, but hardly decisive. Taking, again, a silk dress, costing a few pounds sterling, the total cost of dye is 2d., and a reduction in price of 25 per cent. would save ½d. American prices are not necessarily quite the same as British in their total or in their incidence, but it is clear that the cost of the

dye is in most cases only a small fraction of the total cost and that, save in quite exceptional cases, a moderate rise or fall could not appreciably affect the selling figure.

The Dyeing of Aluminium

SOME very interesting possibilities are indicated in a recent publication on *The Anodic Oxidation of Aluminium and Its Alloys*, by Dr. G. D. Bengough and Mr. J. N. Stuart, issued by the Department of Scientific and Industrial Research (H.M. Stationery Office, pp. 40, 1s. 3d.). This paper deals with the protection of aluminium by the formation on it, by electrolytic means in a chromic acid bath, of a glassy, adherent film of aluminium hydroxide. It is well known that aluminium hydroxide is used as a mordant for many dyes, and although the point was quite subsidiary to the main object of the investigation, a few experiments on the decoration of the aluminium through this means were carried out. "It seemed possible," state the authors, "that the oxide film formed by the anodic treatment of aluminium and its alloys might also adsorb sufficient dye to colour the material. Tests on aluminium and duralumin showed that these could be strongly coloured by simple immersion in a suitable bath after anodic treatment. To get uniform results it is advisable to carry out the dyeing as soon as possible after the anodic treatment. Preferably the material is washed after this treatment and placed directly in the dye-bath. To obtain results of a high degree of uniformity it may sometimes be necessary to etch the material (e.g., in NaOH solution for aluminium sheet) before anodic treatment. This gets rid of any foreign material worked into the surface by rolling, etc. The authors have not made any attempt to test a great number of dyes on the anodic film. The following dyes were found to colour the film strongly: Alizarine Orange (M Paste); Alizarine Delphinol B; Anthraquinone Blue; Alizarine Celestol B; Alizarine Yellow L; Anthracene Blue; Wool Yellow; Solway Blue SE; Solway Blue Black B; and Solway Green E. A dilute solution of the dye in hot water was prepared, and the specimens immersed in this after anodic treatment and washing."

Details of the Treatment

"THE authors," the report states, "have previously noted that two hours' immersion in petrol does not completely remove grease from the anodic film. This was shown with a duralumin strip which had been anodically oxidised in 3 per cent. chromic acid at 40° C., and after this greased with molten lanoline and the excess wiped off. The strip was then soaked in petrol for about two hours and then immersed in a bath of Anthraquinone Blue for ten minutes. Only relatively small patches of the strip became coloured, while the remainder apparently retained sufficient grease to prevent the dyeing of the film. The authors have found that the thick film formed by anodic oxidation in very dilute sulphuric acid (e.g., 0.3 per cent. sulphuric acid at 60° C.) will also take up dyes to give a strongly coloured film. The voltage regulation required differs from that necessary in the case of chromic acid, since anodic pitting occurs more readily with commercial aluminium in dilute sulphuric acid. The shade of colour obtained may differ from that produced by the same dye on the anodic film formed in chromic acid, partly because the film formed in sulphuric acid is less opaque. If the initial cost of the bath presents difficulties, and only moderate resistance to corrosion is required, the authors would suggest that commercial chromic acid be tried in place of the sulphate-free acid. If resistance to corrosion is not required, films formed by anodic oxidation in dilute sulphuric acid, or other suitable bath, may be tried for colouring purposes. The voltage regulation should be worked out in the same manner as has been adopted for chromic acid."

The Fastness of Developed Dyes on Cellulose Materials

Some Interesting Facts About Naphthol AS Dyes

By A. J. Hall, B.Sc., F.I.C.

In view of the extra cost of vat dyestuffs, dyers are always interested in other types of dyes which yield fast shades and are not expensive. The following article deals, from this point of view, with the Naphthol AS series. Recent investigations have, moreover, shown that hot soaping after dyeing cotton with these dyes increases the fastness to light, and the author suggests that this fact indicates the possibility of obtaining fast shades on cotton by simple after-treatment, rather than by using especially fast dyes.

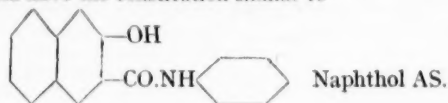
For many years dyers have been told that the public demand for colours of guaranteed fastness is steadily increasing, that vat dyes would be used more and more and, in consequence, direct dyes less and less. Yet each year's statistics relating to dye production and consumption reveal the same high consumption of direct dyes and the comparatively small utilisation of vat dyes. The fact is that vat dyes will be used largely when they are as cheap and easy to apply as direct dyes. Possibly because vat dyes may never be produced cheaply, dyers are always interested in any other type of dye which yields fast shades and is not expensive. At the moment the Sulphur and Naphthol AS dyes are the only cheap dyestuffs which can compare with vat dyes in fastness, and of these the Naphthol AS dyes are of particular interest as fast dyes for cotton and cellulose silks.

Naphthol AS dyes have been largely developed by the Griesheim Elektron Co., and arose as a result of the discovery that the anilide of β -hydroxynaphthoic acid had a substantive affinity for cotton and could be used as a superior substitute for β -naphthol in the production of Para Red—a standard red shade obtained by padding cotton with β -naphthol and afterwards treating (developing) it with a solution of diazotised paranitraniline. To-day Naphthol AS dyes are also being manufactured in England by the British Alizarine Co., of Manchester. The fastness of Naphthol AS dyes is generally excellent to all influences, but in many instances the fastness is largely dependent on the use of correct dyeing methods. It is these peculiar fastness properties which are not only of considerable importance to dyers, but which are of much interest in respect of dyeing theories.

All Naphthol AS dyes are developed dyes. That is, the method of applying them consists of impregnating yarn or fabric with a suitable naphthol and subsequently developing the desired shade by coupling the naphthol with an appropriate diazotised aromatic amine. In developing the present range of Naphthol AS dyes, hundreds if not thousands of new naphthols (all derivatives of β -hydroxynaphthoic acid) and bases have been prepared and the most satisfactory of these selected for industrial use. The following naphthols are now available:

Naphthol.	Constitution.
Naphthol AS ..	Anilide of β -hydroxynaphthoic acid.
Naphthol AS-BS ..	<i>m</i> -Nitroanilide of β -hydroxynaphthoic acid.
Naphthol AS-BO ..	α -Naphthalide of β -hydroxynaphthoic acid.
Naphthol AS-RL ..	<i>p</i> -Aniside of β -hydroxynaphthoic acid.
Naphthol AS-SW ..	β -Naphthalide of β -hydroxynaphthoic acid.
Naphthol AS-G ..	Diacetoacetictoluidide.
Naphthol AS-BR ..	Di-aniside of β -hydroxynaphthoic acid (1 mol. of dianisidine condensed with 2 mols. of β -hydroxynaphthoic acid).
Naphthol AS-BG ..	—
Naphthol AS-TR ..	5-Chloro- <i>o</i> -toluidide of β -hydroxynaphthoic acid.
Naphthol AS-D ..	<i>o</i> -Toluidide of β -hydroxynaphthoic acid.

Naphthol AS-G is not a true Naphthol AS substance, but is included because of its good fastness properties and so that the range may include a good yellow shade. Otherwise all Naphthol AS substances are derived from β -hydroxynaphthoic acid and have the constitution similar to



The bases are drawn from various types of amines, but the following are typical:

Base	Constitution
Fast Orange G base	<i>m</i> -Chloroaniline.
Fast Black LB base	2-Ethoxybenzene-azo- α -naphthylamine.
Fast Red KB base	4-chloro-2-aminotoluene.
Fast Garnet G and GB bases ..	<i>o</i> -Aminoazatoluene.
Fast Scarlet TR base	6-Chloro-2-aminotoluene.
Fast Red TR base	5-Chloro-2-aminotoluene.

The Naphthol AS range comprises yellow, orange, red, scarlet, maroon, blue, and black shades.

From the above, the complex nature and high molecular weight of Naphthol AS dyes is evident, and these factors probably have a definite influence on their insolubility and fastness properties.

After dyeing cotton with Naphthol AS dyes it is usual to wash it thoroughly free from loosely adhering colour (thus increasing the fastness to rubbing) and to give it a hot soaping. It is this latter operation which affects the fastness of the resulting dyeing. In general, hot soaping increases the fastness to light, and the investigations of Loscher (Textilberichte, 1926, 243) show this very clearly. In one series of experiments samples of bleached cotton fabric dyed in the normal manner with the combinations Naphthol AS + Fast Red GL base, Naphthol AS-SW + Fast Red KB base, and Naphthol AS-RL + Fast Red RL base, were subjected to one of each of the following treatments and the light-fastness of the resulting shades determined by exposure to direct sunlight.

Treatments.

1. Washed in cold water.
2. Washed for 5 minutes in water at 50° C.
3. Washed for 5 minutes in water at 100° C.
4. Soaped for 5 minutes at 50° C.
5. Soaped for 30 minutes at 50° C.
6. Soaped for 5 minutes at 100° C.
7. Soaped for 30 minutes at 100° C.

Previous to treatments 4—7 the dyed material was successively washed in cold and warm water.

The results obtained after exposure to sunlight were quite conclusive and are given below, the highest degree of fastness being indicated by the number 5.

Light Fastness.

	1. 2—3
	2. 2—3
Naphthol AS	3. 3—4
+	4. 4
Fast Red GL base	5. 4
	6. 4—5
	7. 4—5
Naphthol AS-SW	1. 2
+	2. 2
Fast Red KB base	3. 2
	4. 2—3
	5. 3
	6. 3—4
	7. 4
Naphthol AS-RL	1. 4—5
+	2. 4—5
Fast Red RL base	3. 5
	4. 5
	5. 5
	6. 5
	7. 5

A further series of experiments on similar lines indicated the same result—soaping at high temperatures increases the fast-

ness to light of the resulting dyeing—the increase of fastness thereby produced being, of course, dependent on the particular dyestuff used.

With these investigations of Loscher must be associated other experiments of Rowe (J. Soc. Dyers and Col., 1926, 207) and Kayser (Textilberichte, 1926, 437), and from these some explanation of the results obtained by Loscher appears possible.

It is the experience of those connected with the large scale dyeing of viscose silk with Naphthol AS dyes that in producing heavy shades the silk frequently becomes "blinded." By "blinding" it is understood that the silk becomes dull, having lost its lustre, and this occurrence is frequently accompanied by a change of shade. Whittaker has drawn attention to the limitations which are thus placed on the use of Naphthol AS dyes for use with viscose silk. In some cases, although blinding does not occur during dyeing, it does occur during the subsequent treatment with soap, particularly if this treatment is carried out above a temperature of 60°C. For example, viscose silk dyed with the combination Naphthol AS-RL + Fast Orange G salt, and afterwards soaped at 60°C. has a bright orange shade and retains its full lustre. If, however, it is then soaped at the boil it becomes dull or blinded, while the shade becomes bluish red. Viscose silk dyed with the combination Naphthol AS-BO + Fast Orange G salt behaves similarly.

Microscopic examination of cross sections of the dyed viscose silk before and after blinding showed that whereas in the lustrous fibres the dye was uniformly distributed within each fibre, in the blinded fibres the dye was present as scattered aggregates. Blinding thus appears to be due to the ability of the aggregates of dye within the fibres to mask the natural lustre by irregular dispersion of incident light rays. It was also significant that the differences in colour between the blinded and non-blinded silk were found to be similar to the differences in colour between the Naphthol AS dyes in crystalline form and their solutions in toluene.

Kayser's experiments are, however, more closely related to the present discussion of the light-fastness of Naphthol AS dyes, since they were carried out with cotton fibres instead of viscose silk. Each cotton fibre consists of a cuticle, an inner layer of cellulose and a central canal of lumen. The lumen usually occupies nearly two-thirds of the fibre, the cellulose layer occupying most of the remainder. When dyed with Naphthol AS dyes, the dye is usually found within the cellulose layer, provided that the dyed cotton is not soaped hot after dyeing. Fig. 1 shows a typical cotton fibre dyed with the

being sometimes observed that the particles during migration become crystalline. With increasing migration and concentration of dye particles within the lumen is associated increasing fastness to light. What is the explanation of these changes?

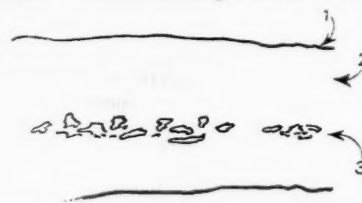


FIG. 2.—TRANSVERSE SECTION OF COTTON FIBRE DYED WITH NAPHTHOL AS-SW + FAST RED KB BASE AND AFTERWARDS SOAPED AT THE BOIL. MAGNIFICATION = 2,500.

1. CUTICLE.
2. CELLULOSE LAYER.
3. LUMEN CONTAINING AGGREGATES OF DYE PARTICLES.

A possible explanation is that during the treatment with boiling soap, the dye becomes solubilised and then migrates in colloidal solution to the lumen, where it is again deposited as a result of coagulation or crystallisation. Support for this lies in the fact that migration does not occur when the dyed cotton is boiled in water alone, or in soap solutions containing salt, but only in soap solutions or water containing an alkali. The increased light fastness is evidently connected with the greater fastness to light of dye aggregates and probably also with the fact that the light is more largely robbed of its destructive properties when it passes through a greater thickness of cellulose before reaching the dye aggregates within the lumen. In other words, the cellulose of cotton fibres is probably able to exert a greater protective action when the dye is in the form of aggregates than when it is evenly diffused throughout the fibre—it being remembered that wool exerts a protective action towards dyes with which it may be coloured.

These recently discovered facts relating to the fastness properties of Naphthol AS dyes are of great interest since they suggest the possibility of obtaining fast shades on cotton by methods involving simple after-treatment rather than by the use of especially fast dyes.

Monel Nickel for Dyeing, etc.

An attractive pamphlet has been issued by G. and J. Weir, Ltd., engineers, Glasgow, describing the uses and qualities of Monel Nickel and pure nickel in the dyeing, bleaching, and finishing of cotton, woollen, and silk textiles and in the manufacture of artificial silk, with some notes on the advantage and economies effected by their use, and illustrations of plant made and used in Great Britain. The dyer's ideal metal, it is suggested, should possess the maximum resistance to corrosion, freedom from reaction with the wide range of chemicals and colours used to-day, combined with the engineering qualities of strength and toughness, ready workability in ordinary workshops, prompt availability, and speedy delivery in all the normal engineering forms. All these stringent requirements, it is claimed, are completely satisfied by Monel Metal. The pamphlet is well written and attractively illustrated, and we may have an opportunity of dealing with it more fully in a later issue.

Dyestuff Licences for November

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during November has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee. The total number of applications received during the month was 645, of which 549 were from merchants or importers. To these should be added 15 cases outstanding on October 30, making a total for the month of 660. These were dealt with as follows:—Granted, 584 (of which 574 were dealt with within 7 days of receipt); referred to British makers of similar products, 59 (of which 51 were dealt with within 7 days of receipt); referred to Reparation supplies available, 6 (all of which were dealt with within 2 days of receipt); outstanding on November 30, 11. Of the total of 660 applications received, 631, or 96 per cent., were dealt with within 7 days of receipt.



FIG. 1.—TRANSVERSE SECTION OF COTTON FIBRE DYED WITH NAPHTHOL AS-SW + FAST RED KB BASE AND AFTERWARDS WASHED WITH COLD WATER. MAGNIFICATION = 4,000.

1. CUTICLE.
2. CELLULOSE LAYER CONTAINING THE DYE.
3. LUMEN.

combination Naphthol AS-SW + Fast Red KB base, the dyed cotton being merely washed with cold water after dyeing. When such dyed cotton fibres are further treated for ½–1 hour in a boiling solution of soap, the particles of dye wander and concentrate within the lumen as shown in Fig. 2—it

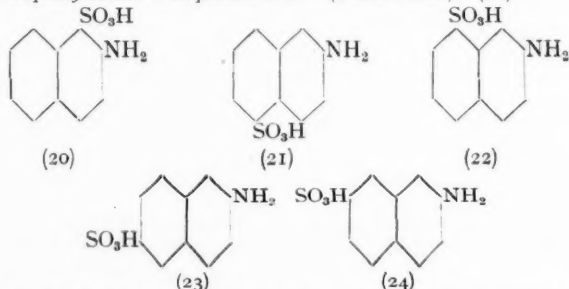
Basic Intermediates for Dyestuffs: No. V.—The Sulphonic Acids of β -Naphthylamine

By "Consultant"

AMONG the simple monosulphonic acids of β -naphthylamine there are several that find no application at all in the dyestuffs industry (for example, the 2-naphthylamine-3-sulphonic acid), while others are used only as intermediates for the preparation of more valuable compounds which themselves are utilised only in an intermediate capacity (e.g. 2-naphthylamine-5-sulphonic acid). Others such as 2-naphthylamine-1-sulphonic acid (Tobias Acid), 2-naphthylamine-6-sulphonic acid (Brönner Acid) and 2-naphthylamine-7-sulphonic acid (Amido-F-Acid) find extensive use directly in the preparation of dyestuffs, mainly as first components in the preparation of azo colours. The disulphonic acids are, if anything, more important to the industry, while one of the trisulphonic acids—2-naphthylamine-3:6:8-trisulphonic acid—is used extensively for the preparation of 2-amino-8-naphthol-3:6-disulphonic acid.

There is one feature among the sulphonic acids of β -naphthylamine that is not apparent in the corresponding derivatives of the α -amine, namely, the ease with which they are prepared from the corresponding naphthols by the action of ammonia. This reaction, which is almost universal among the β -naphthol sulphonic acids, goes under the name of the "Bucherer" reaction and consists essentially of heating the appropriate naphthol sulphonic acid with a mixture of ammonia and ammonium bisulphite under pressure at 100-150° C. After cooling the amino compound can be obtained by a suitable salting-out process.

2-Naphthylamine-1-sulphonic acid. (Tobias acid.) (20)



Methods for the preparation of this substance consist chiefly of the replacement of the hydroxy group by an amino group in the corresponding naphthol sulphonic acid. The Bucherer process is very conveniently used for this purpose and has the advantage of preventing the formation of the β -naphthylamine which is produced as a by-product in most of the alternative processes and which, of course, decreases the yield. In the older and more usual processes ammonia or ammonium chloride without the aid of ammonium sulphite are used. Thus in one process sodium-2-naphthol-1-sulphonate (1 cwt.) and 15-20 per cent. ammonia solution (2-2½ cwt.) are heated in an autoclave at 220-230° C. for 20 hours. The reaction can also be brought about in a rather shorter time (12 hours) by the use of ammonium chloride (¾ cwt.). The ammonia is blown off while the autoclave is still hot, and after cooling to ordinary temperature the β -naphthylamine which is formed during the reaction is filtered off and the residual liquor evaporated, the acid being salted out from the concentrated liquor. Tobias acid is mainly used for the preparation of Lake Pigments of which Lithol Red and Lake Bordeaux B are two outstanding examples.

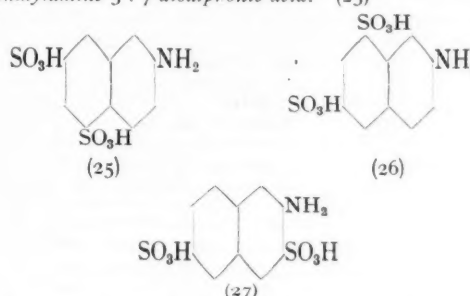
2-Naphthylamine-5-sulphonic acid. (21)

The direct sulphonation of β -naphthylamine leads to the formation of this and the 2:8-acid, together with small quantities of the other isomers. Analysis shows that the average yield from the sulphonation is:—

	Per cent.
2-Naphthylamine-5-sulphonic acid	40
2-Naphthylamine-6-sulphonic acid	5
2-Naphthylamine-7-sulphonic acid	5
2-Naphthylamine-8-sulphonic acid	30

Finely powdered β -naphthylamine sulphate (1½ cwt.) is gradually added with considerable stirring to sulphuric acid containing a little oleum (4½ cwt.). The lid of the pan is placed in position and stirring is continued at ordinary temperatures (15-20° C.) for a period of from 48-70 hours, the end of the reaction being determined by frequent addition of a sample to dilute ammonia, the reaction being considered over when a clear solution is obtained. On pouring into much water the 2:5 and 2:8 acids are precipitated. They are converted into their sodium salts and extracted with 90 per cent. alcohol, in which the sodium salt of the 2:8 acid (22) is insoluble. The acid may be obtained from the alcoholic extract by first removing the solvent by distillation and then precipitating the acid by the addition of hydrochloric acid to a solution of the residual sodium salt in water. Further purification, when desired, can be effected through the barium salt. The chief use of this acid is for the preparation of the 2-naphthylamine-5:7-disulphonic acid.

2-Naphthylamine-5:7-disulphonic acid. (25)



This compound is prepared from the previous by prolonged sulphonation with 20 per cent. oleum. The finely ground 2:5 acid is stirred at ordinary temperatures with an excess of the acid for 4½-5 days, after which sulphonation to the disulphonic stage is complete. Some 2-naphthylamine 1:5-disulphonic acid is produced at the same time and the two are separated by pouring the sulphonation liquor into milk of lime, cooling, filtering and converting the calcium salts in the filtrate to the potassium salts. On concentration, the 1:5 disulphonic acid K salt separates out, and the 5:7 acid is obtained on acidification.

An almost identical process is in use in some works in which the 2-naphthylamine-7-sulphonic acid is sulphonated.

2-Naphthylamine-6-sulphonic acid. Brönner acid. (23)

This acid can be easily produced by the Bucherer process from Schaeffer acid. This substance, 2-naphthol-6-sulphonic acid, when heated with 40 per cent. ammonium hydrogen sulphite and 20 per cent. ammonia gives a fairly good yield of the Brönner acid. The latter is also manufactured by baking a paste of equal parts of β -naphthylamine and concentrated sulphuric acid at 200-210° C. for two hours. The residue is converted by solution in water with the aid of soda ash into the sodium salt from a concentrated solution of which the acid can be obtained by salting out. Its principal use is as a first component, in which capacity it enters into the preparation of Cloth Red 3G, Dianol Red B, Milling Yellow Brilliant Congo R, Brilliant Purpurin 4B, etc.

2-Naphthylamine-7-sulphonic acid. Amido-F-acid. (24)

This acid, like the compound previously mentioned, can be made quite easily by the Bucherer method, although there are several other processes which are still in use for its preparation. Thus it can be prepared from 2-naphthol-7-sulphonic acid (1 cwt.) by heating with 20 per cent. ammonia (2 cwt.) in an autoclave for six hours at 250° C. In another alternative process the starting point is sodium naphthalene 2:7 disulphonate (¾ cwt.), which is heated for ten hours at 200-250° C. with 40 per cent. sodium hydroxide (¾ cwt.). The melt is cooled somewhat and ammonium chloride added (14 lb.) together with water (5 gallons), and the whole is then

heated for a further period of ten hours at 200-250° C. The acid is isolated in the manner described above. It is used for the preparation of dyes of the Diamine Red 3B and Rosazurine class.

2-Naphthylamine-3:6-disulphonic acid and 2-naphthylamine 6:8-disulphonic acids. (27) and (26)

These two exceedingly important compounds are produced

almost exclusively from the corresponding naphthol compounds by the Bucherer reaction. The former is used considerably for the manufacture of such dyes as Dianol Brilliant Extra Red, Brilliant Congo G, Pyramine Orange 2R, Salmon Red, Benzo Fast Red 9BL, Trypan Red, etc., while the latter finds application in the manufacture of γ -acid Crumpsall Yellow, the Wool Blacks and the Diamine Blues.

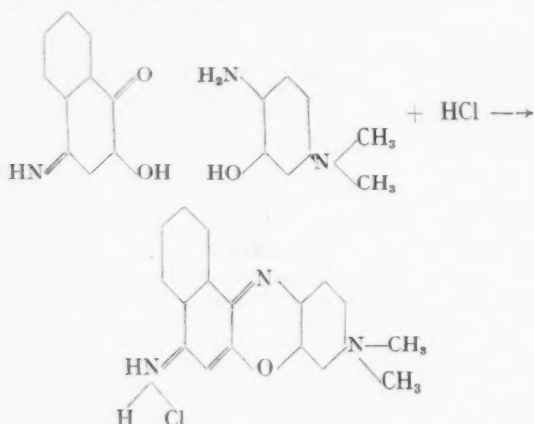
Dyes and their Application: Recent Technical Progress

By L. J. Hooley

THE basic colours which practically monopolised research during the first twenty or thirty years of the synthetic industry are now comparatively neglected. The majority of these colours having been known for many years, there has been ample time for the best to come to the front. In brilliance, which is one of their most important features, the highest level was already reached years ago, and as regards economy in methods of production the possible avenues of improvement have already been largely explored so that this field has not now the interest of the others. These basic colours, however, were the ones which laid the foundations of the synthetic industry and which have inspired an enormous amount of research work, not only empirical and technical, but also on complex questions of constitution. A few references to the most recent work will be given, however, to show that these colours are not entirely neglected. They will not include any of the triphenyl methane series.

Oxazines

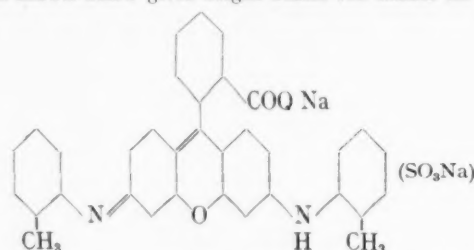
Kehrmann, whose work on the basic dyestuffs is already well known, describes a new synthesis of oxazines in *Helv. Chim. A.* IX, 867, by condensing quinones with ortho amino phenols. For example, the dimethyl derivative of Nile Blue is obtained from 4-amino-1,2-naphthoquinone (hydroxy naphthoquinone imine) and amino-*m*-dimethylamino phenol by heating in alcoholic solution on the water bath.



This is simpler than the usual method in which nitroso bodies are used, as with these, direct condensation first takes place to give the leuco body, which is then oxidised at the expense of further nitroso compound. A large number of examples are given, details of which must be sought in the paper. It will be noticed that Kehrmann uses the para- and not the ortho-quinonoid formula. The absorption spectra of several of the compounds synthesised are given. Goldstein and Radovanvitch use the same method of synthesis in another paper in this journal for the production of mono substituted dinaphthoxazines, which branch of the naphthoxazines has not been dealt with before. Thus the compound obtained using 1,2-amino hydroxy naphthalene instead of the second component in the equation above is fuchsine red and that from the 2,1 compound orange and both are weak bases. Details of the production of oxazine dyes as well as other basic dyes as safranines and rosanilines are given by Coblenz (*Chem. Ztg.*, 50, 494), including the advantages of zinc chloride in their preparation and the production of dyes from Meldola's Blue, Naphthol Blue, etc.

Rhodamines

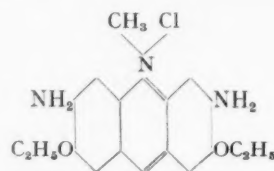
The Rhodamines are usually dyed on wool, silk, and cotton with a tannin and tartar emetic mordant, although in the case of the B and G brands, where the carboxylic acid group is free and not present as its ethyl ester, dyeing on wool and silk can be done from a natural bath without mordanting. They can be used for wool and silk from an acid bath by sulphonating. As examples of the latter we have the acid violets, obtained by condensing fluorescein chloride with aniline or toluidine and sulphonating. A simplification in the production of these is seen in B.P. 251,644 (D.H.), where the sulphonated derivatives are produced in one stage, starting from phthalic anhydride and aryl-*m*-amino phenols, and using sulphuric acid which serves the double purpose of condensation and sulphonation. The three constituents are melted together at about 140-170°C., until solidification takes place, when the dyestuff is extracted with alkali in the usual manner. The colours are yellower in shade than the corresponding ones obtained by the after sulphonation process. The product from *o*-tolyl-*m*-amino phenol shown below gives bright bluish red shades on wool.



Using the *p*-quinone formula the general analogy between this and the other compound already shown can be seen.

Acridines

The Acridine group of the basic dyes has at the present time more interest for research purposes for drugs than for colours. Since the recognition of the trypanocidal action of acriflavine by Ehrlich and Benda in 1910, these products have attained considerable medical importance. As far as trypanocidal action is concerned, they may be regarded as marking stages on the way to the symmetrical ureas of the Fourneau 309 and (probably) Bayer 205 type, which latter are enormously more efficient for the purpose. Apart from this they have powerful bactericidal action, and so form very valuable antiseptics. Acriflavine and trypaflavine were used extensively during the war. The B.D.C. have devoted considerable attention to these, and in a recent patent, B.P. 248,182 (B.D.C., Perkin and Burger), new derivatives of type similar to

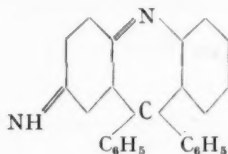


which is a diethoxy acriflavine, are described. The alkoxy groups may be interchanged with the amino groups, and the compounds may be either of the acridine or acridinium type. The acridine bodies are synthesised in the usual manner by condensing two molecules of the requisite diamino dialkoxy body with zinc chloride, oxalic acid and glycerine, or in the case of those where the groups are interchanged, by starting with ortho nitro alkoxy benzene, condensing with formalde-

hyde, reducing to the diamino diphenyl methane, nitrating and reducing, and finally forming the acridine; the acridine compounds are converted to the acridinium ones by acetylation, alkylation, and hydrolysis.

Carbazines

By nitrating diphenyldihydro acridine, reducing to the amino body and oxidising, dyestuffs of the carbazine series are obtained.



The position of the resulting groups in the various nitration products has not previously been determined with certainty, although Kehrman has assigned these by comparison with corresponding oxazines and thiazines. Kehrman's conclusions have been now confirmed conclusively in the case of *p*-amino diphenyl carbazine, and the corresponding 2,7 diamino body. By synthesising these from amino derivatives of methyl phenyl anthranilate and phenyl magnesium bromide by the Grignard reaction, as previously used by Bayer, Villiger, and Basset for the unsubstituted diphenyl carbazine (*Helv. Chem. A.*, IX, 772), it has been shown that the bodies which by this synthesis must be the *p*-amino- and the 2,7 diamines, are identical with those to which these constitutions were assigned by Kehrman. The carbazine dyes have not been used commercially.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

THE market for dyestuffs was maintained at about the October level, the general tendency being to droop a little. There can be no doubt that November was, in general, a difficult month; the impending cessation of the coal stoppage and its promise of cheaper coal, together with some uncertainty regarding the stability of the present price for cotton, had the effect of slowing down activity. It is not expected that any marked improvement will take place before the new year.

The meeting of Mr. Keynes and the general committee of the Cotton Spinners' Federation, respecting the policy of organised short time, may lead to something useful in spite of Mr. Keynes' summary, "Lancashire in short must go to hell her own way, for any other route to any other destination is, in the circumstances, theoretical." The short-time system was introduced only just in time to prevent the event which Mr. Keynes foresees; nobody could possibly claim that it could lead to material progress, but it certainly has served its purpose as a preventive measure. Before any material progress is made, measures as drastic as those Mr. Keynes suggests will have to be taken, but obviously the choice of the proper time is a very important factor. The position is, roughly, that the China market is in a state of chaos, and offers no hope of any immediate revival, but on the other hand there is an abundance of cheap cotton, which should be a stimulus to general demand. To take the fullest advantage of any increased demand money is required; the spinners, in too many cases, have neither money nor, in fact, anything left to pledge for a loan. It is a problem which the cotton industry as a whole will have to solve; the mere bankruptcy of the weaker firms is no solution.

During the month the world movements which have led to the formation of the I.C.I. have received much consideration, and the general conclusion appears to be that the threat was from the U.S.A. The Germans have held this view for a considerable time, and it may be, therefore, that a closer union between British and German interests is to be anticipated. The meetings between German and British industrialists which are now taking place may possibly be based on a similar mutual interest.

Yorkshire

Although it came late in the month and lacked definitiveness, we know that the end of the coal stoppage has come and are grateful to November for that relief. From a practical point of view, however, November must be regarded as one of the long series of strike months providing its quota to the losses borne by the dyestuffs industry. Huddersfield textiles anticipated the end by getting very busy, improvement being most marked with reference to best grades in the worsted section, in which some of the mills are working overtime. Further, it is satisfactory to note that most of the new trade is for export. Spinners of coloured worsteds are fairly well employed, and one firm is reported to have over three months' work in hand. Reports from the heavy woollen district are depressing.

The most regrettable feature of the Yorkshire dyestuff industry during November has been the accident at the Castleford works of Hickson and Partners, Ltd., and the more to

be deplored since it involved loss of life. A report of the affair has already appeared in THE CHEMICAL AGE, but we are informed that accounts generally have been exaggerated. The damage to property was slight and dislocation of processes delayed output of one or two dyestuff intermediates and necessitated for a little time a rationing of sulphur blacks. Routine throughout the greater part of the works is now normal, and the department in which the fire occurred well on the way to complete restoration.

It has been noted that the German firms appear latterly to have entirely suspended the shipment to China of certain products, such as sulphur black, and thought in Yorkshire is turned to the possibilities of the country as a market for Yorkshire wares in the event of the revolutionary faction being evicted.

Supplies of benzene from local coke ovens are not expected to materialise before the New Year, and prices of nitrobenzene and aniline, therefore, are not expected to move this year very materially from 7d. to 9d. per lb. respectively. The continued shortage of benzene must have the effect further of carrying on the shortage of other intermediates for some weeks still and maintaining firmness of prices. A hardening of prices of continental-made sodium sulphide has been observed, and the cause is perhaps explained by rumours of the formation of a manufacturing ring. On the other hand, makers of dyestuffs in Yorkshire continue to fill the rôle of benevolent society towards the consumer by cutting their prices; big drops in those for certain acid colours have been made during the last week or two.

Midlands

Dyehouses in the Midlands are, on the whole, working rather longer hours than a month ago. Prospects of a settlement of the coal dispute doubtless contributed to the improvement which has been more apparent in the woollen section than in any other.

Dyers consume more fuel than any branch of the textile industry, and are anxiously looking for reductions in coal prices. Several important firms of commission dyers inform us that their recent stock-takings reveal disastrous results owing to high-priced fuel.

Woollen yarns suitable for pullovers are selling very well. Coarser yarns are flat. Woollen fabric and hose are better than a month ago.

Cotton.—Hose very slack; manufacturers complain of very keen competition from the continent. Sewing and backing cottons are in fair request. Cheap knitted fabrics for underwear are selling very well, and fadeless lace curtains are a steady trade.

Artificial Silk.—Panel hose still very depressed; inquiries for small quantities of the cheaper lines are being received. Knitted fabric for underwear, moderate. Crepe cords and yarns for hand knitting, dull.

Natural Silk Hose.—Firms producing satisfactory low-priced goods are selling them readily.

Leather.—Chrome calf for men's footwear has been selling fairly well. The same remark applies to willow calf and other suitable leathers for Russian boots. Upholstery and book-binding leathers are in fair demand.

Scotland

Since last month's report the coal dispute has practically settled itself, and the dominating influence of the last six months has thus disappeared. Its ending has been quieter than its beginning, and if the industry could manage to carry on quietly for a few years everybody concerned would be happier.

It is a little early yet to measure the effect of the return. In Scotland it has brought an improvement in the dyeing and finishing trades of the West and the Glasgow and Paisley districts. In the South the excellent conditions in the wool

industry still hold; but for this the end of the coal dispute is not responsible. Makers of cheviots and tweeds have their hands full, while there is also some revival in saxonies. The wool dyers are correspondingly busy.

Apart from wool, matters are much the same in this as in the other parts of Scotland. Dyestuffs are quiet, and maintain the level of last month. There has certainly as yet been no very great leap forward in business. Christmas and the end of the year being near may cause a certain amount of marking time, and some people will go cautiously until the end of the year shows them where they stand.

The Dyestuffs "Who's Who": (8.)—Mr. R. S. Horsfall

MR. RONALD S. HORSFALL, a native of Yorkshire, was educated at the Wheelwright Grammar School, Dewsbury, and graduated in the Honours School of Chemistry at Leeds University, where he specialised in Colour Chemistry and Dyeing, thus following a family tradition.



MR. RONALD S. HORSFALL

Leaving Leeds at a time when students of promise were in demand by the German dyestuffs firms, Mr. Horsfall joined the Ludwigshafen headquarters of the Badische Co., by whom he was sent in due course to the United States, with the introduction and development of the application of the then new series of Indanthrene colours as his special brief.

Shortly after the outbreak of the War in 1914, Mr. Horsfall joined the research staff of Levinstein, Ltd., but it was soon recognised that his knowledge and experience as a colourist would be a valuable asset to the dyehouse, then in embryo, and he was accordingly transferred to that department. After Levinstein, Ltd., and British Dyes, Ltd., were amalgamated to form the British

Dyestuffs Corporation, Ltd., Mr. Horsfall was appointed chief colourist to the new company, a position which he still holds.

To fill successfully such a position in the largest dye-making concern in the country requires not only a thorough knowledge—acquired only through long experience—of the many branches of the application of dyestuffs, but also at least an intelligent acquaintance with the chemistry and manufacture of these products, and, lastly, a good measure of sound judgment and tact; for the colourist department of a dye factory is the half-way house between the manufacturing section of the works and the consumer of its products. It is a collector of information from the consuming trade for the benefit of the works, and a distributor of information of a different kind to the consumer. It is thus a service department in a much bigger sense than is generally appreciated by those who have not had the privilege of association with its functions, and who are apt to regard its work as ending with testing of samples, matching of shades, and controlling works processes. Those who are in the best position to judge will unhesitatingly agree that Mr. Horsfall possesses these essentials to a remarkable degree.

One of the most noteworthy technical achievements of the British Dyestuffs Corporation is its contribution to the solution of the difficult problem of the dyeing of cellulose acetate silk. Mr. Horsfall has been closely associated with this work from the commencement, and may fairly claim to be one of the foremost experts in this branch of dyeing.

Mr. Horsfall's activities, however, are not bounded by the factory and the dyehouse. Throughout the operation of the Dyestuffs (Imports) Regulation Act, he has played a leading part in upholding the cause of the dye-makers of Great Britain. He is a member of the informal joint technical committee of dye-users and dye-makers. He is also a member of the Council of the Research Association of British Paint, Colour and Varnish Manufacturers, and of the Revision Committee of the Colour Index of the Society of Dyers and Colourists.

A Super-Steam Accumulator

BELOW is a photograph of a huge steam accumulator specially built for Scottish Dyes, Ltd., by the Fairfield Ship and Engineering Co., on its way from the makers to the dyestuffs works at Grangemouth. The accumulator attracted considerable notice on account of its size, and incidents of its progress were included in the *Pathé Gazette*.



[Reproduced by courtesy of the "Daily Record," Glasgow]

United States

ACCORDING to a preliminary report of the United States Tariff Commission, covering the important points in the ninth annual census of dyes and other synthetic organic chemicals, the production of coal tar dyes by seventy-five manufacturers in the United States of America in 1925 was 25 per cent. greater than that of 1924. A decline of 13 per cent. in the prices of domestic dyes during the year was concomitant with the increase in production. There were fewer manufacturers, several firms closing down in the press of greater domestic competition. A record production of vat dyes took place, with a 43 per cent. increase in this class of colours over the 1924 output. Both imports and exports of dyes were also considerably higher than in the previous year. Seventy-five firms reported production of dyes in 1925 (six of which made only bacteriological stains and indicators). The output of coal tar dyes by seventy-five U.S. firms above-mentioned was 86,345,438 lb. in 1925, as compared with 68,679,000 lb. in 1924. The total sales in the two years were 79,303,451 lb., valued at \$37,468,332 and 64,961,433 lb., valued at \$35,012,400 respectively. The increased production was in part due to the improvement of the export trade of which Indigo and Sulphur Black were the principal items. More than 90 per cent. of the total quantity of dyes consumed in the United States in 1925 were of domestic manufacture, and certain of the lower priced colours were exported in significant amounts.

Metallurgical Section

Published in the first issue of "The Chemical Age" each month

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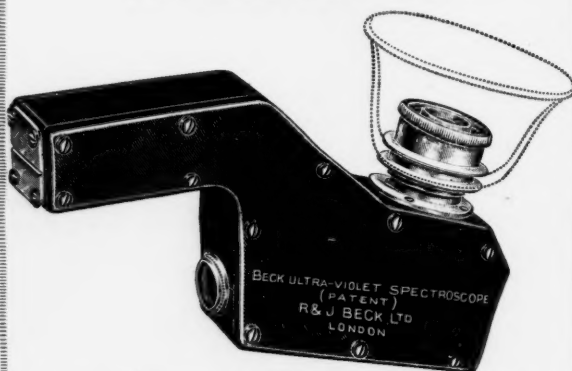
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Chemistry and Metallurgy of Zirconium and Hafnium

By G. Malcolm Dyson, Ph.D., A.I.C.

We publish below an account of the occurrence, preparation, properties, and uses of the elements zirconium and hafnium. From time to time in the past, Dr. Dyson has dealt with other non-ferrous metals in these columns, and we hope to publish further articles dealing with this field in the future.

WHILE the properties of the element zirconium are comparatively little known, it and its compounds are undoubtedly among the more interesting of the rarer elements, and constitute a series of substances which are destined to play no inconsiderable part in the future of industrial and metallurgical chemistry. Hafnium, on the other hand, in spite of its availability on a comparatively large scale—for a so-called rare element—is still too young a member of the family of known elements to have taken its correct place in applied science, and for the present must be regarded as somewhat of a "dark horse."

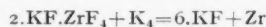
Occurrence of Zirconium

Zirconium was discovered as early as 1789 by Klaproth, whose careful and painstaking analyses of mineral substances gave him the privilege of unmasking the individuality of many elements. In this case, his analysis of a specimen of jargon from Ceylon revealed the presence of about 68 per cent. of an element which had hitherto been unknown, and which was soon afterwards found in a considerable number of minerals, in which the so-called rare earths occurred. Zirconium is widely, not to say abundantly, distributed in nature, principally as the silicate, which constitutes the basis of zircon and several semi-precious minerals, including the hyacinths or jacinth. Under the latter name we find Biblical reference to zircon, while "hyacinthus" is referred to by several Latin authors (including Agricola) as a hard clear stone much used for intaglio work. Among the principal zirconium minerals, excluding zircon, are:

		Percentage Content of ZrO_2
Baddeleyite	A native zirconium oxide	Up to 99
Orvillite	$8ZrO_2 \cdot 6SiO_2 \cdot 5H_2O$	Up to 70
Oliverite	$3ZrO_2 \cdot 2TiO_2 \cdot 2H_2O$	63-64
Zirkelite	Zirconium silicate	40-50

while in addition, several hundred minerals are known which contain between five and thirty per cent. of zirconia.

Considerable difficulty has been experienced in preparing the metal, even in a state of comparative purity. Thus Berzelius in 1824 prepared an impure pulverulent zirconium by the reduction of potassium zirconium fluoride with metallic potassium:



The obvious method of reducing the oxide to the metal by the Goldschmidt process, either with aluminium, magnesium or "misch-metal" suffers from the disadvantage that zirconium alloys very easily with these elements. The purest specimens of zirconium yet produced are probably those of Weiss and Naumann on the one hand, and of Lely and Hamburger on the other. The former investigators used the impure zirconium obtained by the Berzelius process and compressed it into pencils between which they struck an arc under reduced pressure in an atmosphere of hydrogen. The molten zirconium which dripped from the upper electrode pencil collected on the lower into a coherent mass of zirconium which was approximately 99.76 to 99.89 per cent. pure. Lely and Hamburger prepared pure zirconium by heating zirconium tetrachloride and sodium in a bomb by means of the electric current. The metal obtained in this way con-

sisted of brilliant shining plates, which were found to be ductile in the extreme.

Commercial zirconium is often obtained by the aluminothermic reduction of the oxide and contains about 90-98 per cent. of the metal. The commercial application of zirconium metals as a filament for incandescent electric lamps has not as yet been very wide, on account of the expense of production. The high conductivity and fusing point of zirconium, however, make it practically certain that if a cheaper method of extraction became available, it would replace the more costly tungsten, especially for the manufacture of high power gas-filled lamps. Recently a British patent has been filed covering a method by which a mixture of zirconia and aluminium together with sodium silicate is formed into a briquette. On passing a fairly heavy electric current through the mass, reduction is initiated and a fairly pure zirconium results. This metal can be drawn into the fine filaments necessary for the production of incandescent lamps. There are, however, a number of processes patented which allow of the formation of a stable filament either from the pulverulent zirconium, or from zirconium produced *in situ* by the process of alkali metal reduction. In the former process the powdered zirconium is reduced to an impalpable state and mixed with an organic substance such as carbon disulphide or benzene in which rubber has been dissolved, and in this way a paste is formed which can be squirted through an appropriate hole into filament shape. The solvent rapidly evaporates, leaving a filament which, on electrical heating in a reducing atmosphere, yields a filament of metallic zirconium. Such filaments are, however, very brittle and lamps made from them have a corresponding short life, especially under conditions involving much vibration. To avoid this, a scheme has been devised for the manufacture of the filament *in situ*. The salt used is hydrated zirconium oxalate, which by reason of its colloidal nature can be made into a tenacious paste (resembling farina paste) with metallic zirconium powder. This, when squirted and heated electrically, gives a thin filament of zirconium. It has been found more satisfactory to substitute tungsten powder for zirconium powder in this operation, since the filament so obtained is highly tenacious.

Zirconium Filaments

For the direct preparation of the filament from the pure metal, the usual double tube method can be employed; it is usual, however, to coat the zirconium with a thin layer of zirconia before enclosing in a nickel tube preparatory to drawing. Both the nickel and the zirconia are removed by acid treatment. Still another method of obtaining a zirconium filament is to mix a highly concentrated colloidal suspension of zirconia with powdered antimony, squirting and hardening electrically. The presence of the antimony is said to give just the extra modicum of conductivity that is required for the preparation of a perfect filament. An entirely novel, but more expensive, filament is obtained from a mixture of zirconium nitride (90 parts) and powdered metallic rhodium (10 parts). Such a filament conducts as well as a purely metallic one. Furthermore, the presence of a small quantity of zirconium modifies and almost removes the brittleness from tungsten filaments. Thus, in one patent, powdered

tungsten and zirconium are mixed with tin chloride and a cellulose acetate vehicle, or a glacial acetic acid collodion.

The useful alloys of zirconium are few in number. Certain of them, notably the ones with iron, have been used or proposed for use in the production of filaments, but they have not met with unqualified success. The theoretical principle which underlies their use in this direction is that of "selective radiation." When a heated filament is in such a condition it emits more light than corresponds to the temperature at which it is maintained, thus indicating a lower wattage per candle power than that of the average metal filament lamp. One alloy used for this purpose shows the following percentage analysis: zirconium 65, iron 26, titanium 0.12, and aluminium 7.7. Certain zirconium alloys have been found useful for the scavenging of cast steel. Thus, for instance, in casting steel, the addition of 1 per cent. by weight of a 20 per cent. alloy of ferro-zirconium produces a remarkable freedom from blowholes, etc., and a considerable increase in tensile strength, presumably owing to the simultaneous removal of both oxygen and nitrogen.

Alloys with aluminium are known and are readily obtained. They are very refractory, and are but little affected by chemical reagents. They have been proposed for use as a substitute for platinum in the production of chemical apparatus, but the difficulty of working the alloy into thin sheets and plates of any considerable dimensions stands seriously in the way of their adoption. Ferro-zirconium, it may be added, can be very easily produced aluminothermally; indeed, the presence of the magnetic oxide of iron seems to facilitate the whole process of reduction.

Various alloys of zirconium with steel have been used both for the production of cutting tools and for the manufacture of anti-corrosion steel. An alloy of nickel with 10 to 30 per cent. of zirconium gives a high-speed tool metal which wears exceedingly slowly. Cobalt may be substituted for nickel with even greater advantage, and one or more of the chromium group of metals may be substituted for part of the nickel. Thus, up to 35 per cent. of molybdenum or 25 per cent. of tungsten may be added to the nickel-zirconium or cobalt-zirconium alloys, with a considerable increase in their efficiency. One "patent" tool steel has the following percentage composition: nickel, 76.2, zirconium 4.8, aluminium 2.0, silicon 5.9, tungsten 3.8, iron 6.8, and carbon 0.29; while a proprietary brand of anti-corrosion steel contained 2 per cent. of zirconium and silicon. A curious alloy which is noted for its resemblance in many physical properties, including resistance, to platinum has the percentage constitution: zirconium 6.8, niobium 53.5, and tantalum 39.7. It is said to be used in the preparation of resistant chemical apparatus.

Zirconium Compounds

The chief zirconium compound of interest is the oxide, zirconia, which can be prepared in fairly large quantities at a comparatively cheap rate. Its low conductivity both for heat and electricity lead to its use as an insulator both in furnaces and in electrical apparatus. It has, also, an extremely refractory nature, commencing to melt only at a temperature of 1,800° C. In addition it can be easily converted into blocks which are not appreciably porous, so that solids can be fused in zirconia crucibles with comparative impunity, especially as it is not appreciably attacked by many chemical reagents, including strong acids and alkaline fusion mixtures.

Its use as a refractory has one more advantage—namely, its long life. Thus in a series of tests carried out in connection with the refractory linings of various continental closed hearth steel furnaces it was not only found that 2 in. of zirconia lining gave the same insulating power as four of chamotte, but also that the lining lasted four times as long. It may be used as a protective coating for a thicker layer of some cheaper refractory.

The use of zirconia as a heat insulating material has led to its manufacture in the form of crucibles, dishes, and pyrometer tubes. These are compact, not easily broken, and withstand sudden changes of temperature. They can, in point of fact, be plunged red hot into water without fracturing. They are found to be of considerable use in high temperature electric furnace operations, and zirconia coverings have also been used to protect the iridium bar in the Heraeus furnace. The inherent fragility of the "Vitrosil" fused silica ware can be lessened by the incorporation of zirconia with the quartz

material, although the increased opacity of the ware does not meet with universal approval. The opacifying powers of zirconia have led to its adoption as an opacifying agent for enamels and glazes. It is less expensive than the amount of stannic oxide required to do the same work, and is not open to the same objections on hygienic grounds as are the compounds of arsenic and antimony.

Among the other uses of zirconia, we may mention the use of colloidal zirconia as a purification material for sewage and the use of the impalpably powdered oxide as "Kontrastin," a patented contrast material used in the production of X-ray photographs. The textile industry has to some extent adopted zirconium, in the form of hydrated sulphate or acetate, for the weighting of silk and as mordants in certain dyeing processes. It may be mentioned in passing that zirconia forms the emissive unit of the Nernst lamp. Other zirconium compounds have not met with any extended use, and in general chemical properties resemble the compounds of silicon, especially in the formation of zirconates and zirconyl compounds.

Hafnium

I make no apology for the introduction of a note or two concerning hafnium, for it is an element which has, for all chemists, an interest as an example of accurate scientific prediction. Just as Mendelejeff, from considerations of the Periodic Classification, predicted with astonishing accuracy the properties of germanium, so Hevesey was able to deduce, from the quantum theory of atomic structure, the properties of a missing element, now known as hafnium.

Thus, considering that the facts of physical research have shown us that the chemical properties of an element are intimately associated with its outer ring of electrons and with that ring alone it only remains for us to find in our periodic table a series of elements whose outer rings are identical and whose inner shells differ, in order to bring to light a series of elements that are chemically very closely allied. The rare earths form an excellent example of such a series. Thus, in the table below, which indicates the electronic arrangements of the various elements concerned, we see that element 55, caesium, has six shells, the first three complete and the others represented, but incomplete. So long as electrons are added to the outer shell of caesium, elements will be formed that differ from caesium very considerably in their chemical properties; for example, numbers 56 and 57, barium and lanthanum. After barium, however, we see that there is a series of elements which must (according to physical data) owe their individuality to alterations of the inner groups of electrons, the outer group remaining the same. In actual fact the two outer shells of the elements from cerium to lutecium remain unaltered, while the fourth shell increases its complement of electrons from eighteen to thirty-two—the maximum theoretical number. This series of elements is, of course, the rare earths, the chemical properties of which are so similar that their separation one from another, which has been successfully accomplished, can only be described as one of the most brilliant achievements of chemical science.

TABLE SHOWING THE ELECTRONIC STRUCTURE OF THE RARE EARTHS.
Atomic Element. Composition of electronic shells.

No.	Element.	No. 1	2	3	4	5	6
40	Zr	2	8	18	8	2	(2)
55	Cs	2	8	18	18	8	—
56	Ba	2	8	18	18	8	2
57	La	2	8	18	18	8	1 (2)
58	Ce	2	8	18	18	1	8 1 (2)
59	Pr	2	8	18	18	2	8 1 (2)
..	..						
..	..						
..	..						
71	Lu	2	8	18	32	8	1 (2)
72	Hf	2	8	18	32	8	2 (2)

The structure, however, of element 72 will, on reference to the table, be seen to be similar to that of the rare earths but different in this one particular—that is, it is the fifth shell that has an increased number of electrons, and not the fourth as in the rare earths. From this data Hevesey predicted that the new element 72, when discovered, would differ more markedly from the rare earths than these elements do among themselves, and that it would resemble in the highest degree that element whose electronic structure most nearly approached its own. Inspection of the table will show that zirconium is

the element whose inner structure most nearly approaches that of the new element. From this data Hevesey made the following predictions:

1. The new element would probably show a general similarity to zirconium.
2. It should possess a universal quadrivalence.
3. It would probably accompany zirconium in nature.
4. It would be comparatively widely distributed.

Upon examination of the X-ray spectra of a Norwegian specimen of zircon mineral, lines were observed which corresponded with those predicted by interpolation, and in a remark-

ably short time a comparatively pure specimen of the new hafnium oxide was prepared from zirconium minerals. Since then hafnium has been isolated from a great many zirconium ores, and the metal and its compounds have been minutely examined. They show a great similarity to zirconium, especially in the matter of valency, which appears to be universally four. Whether or not the metal hafnium will be found to possess properties which are superior in any way to those of zirconium, or whether it will evince new properties which will render it of importance industrially, time alone will show. There is no doubt that its discovery is one of the most fundamental of recent additions to chemistry.

The I.G. and the Metal Industry

Notes on Recent Developments

The German I. G. Farbenindustrie Aktiengesellschaft has now turned its attention to the non-ferrous metal industry. In the facts given below, which have been obtained from the German technical press, there is evidence that the movement has already been carried out on a large scale. In our monthly notes and comments in this supplement we give an account, which came to hand after this article was written, of the "trustification" which is proceeding in the German iron and steel industry. These two movements deserve the close attention of British metallurgists.

REPORTS have lately appeared in THE CHEMICAL AGE of the remarkable expansion of the I.G. Farbenindustrie Aktiengesellschaft. Originally formed by the fusion of a number of dyestuff and chemical companies, this German trust, by the absorption of many other concerns, has now grown to such an extent that it exerts great influence in a number of chemical and allied industries. Among these is the electrometallurgical industry, and the following notes, compiled from information which recently appeared in *The Chemiker-Zeitung*, are of great interest in this connection.

Absorption of Griesheim-Elektron

In Germany, little competition prevails in the electrometallurgical industry, at the head of which may be placed the Griesheim-Elektron concern, now absorbed in the I.G. Apart from its works in Griesheim and elsewhere, 10 in number, reference may be made to the very large establishments in Bitterfeld, to which place a part of the Griesheim works have now been transferred, and where also the Elektrochemischen Werke G.m.b.H. (which originally belonged to the Allgemeine Elektrische Gesellschaft) have been acquired. In addition, the Griesheim concern possesses strong interests in the Elektrochemischen Werken Horrem A.-G. in Horrem-on-Rhine, and in the Elektro-Nitrum A.-G. in Rhina, and also owns the Deutsche Molybdänwerke (molybdenum works) in Teutschenthal. Among the other electrochemical works of the I.G. may be enumerated the Gesellschaft in Knappsack, and the Dr. Alexander Wacker-Gesellschaft für chemische Industrie in Burghausen and Munich. The Griesheim-Elektron concern possesses its own aluminium works in Bitterfeld, producing 5,000 tons per annum. At present, Germany still imports the greater part of the bauxite required for the production of aluminium, but for some years past the Griesheim company has been investigating the possibility of producing pure alumina for this purpose from inferior German aluminiferous materials. This is a very important problem, as the world production of bauxite is 1½ million tons. It appears, incidentally, that the Griesheim patents affecting the production of electro-metal have been sold in the United States for 600,000 dollars.

One of the special domains of the Griesheim-Elektron concern is the production of light alloys. In many lines, work is carried on in close connection with the Metallgesellschaft in Frankfurt, which also manufactures these alloys. Magnesium, calcium, sodium and barium are all alloyed in greater or less quantity with aluminium, and all these metals and alloys are produced at Bitterfeld. Here also are produced cerium-iron alloy (for the production of pyrophoric masses, 1 kg. of cerium-iron alloy replacing 5 million matches) and metallic cerium. Other iron alloys, especially ferro-tungsten and ferro-molybdenum, are made in Bitterfeld and Teutschenthal. The I.G. possesses copper foundries in Hamburg and Duisburg.

In conclusion, it is worth while enumerating the list of

electrometallurgical and electrochemical companies in which the I.G. is interested, or which it has absorbed. These are as follows: Chem. Fabrik Griesheim-Elektron, Frankfurt; Alexander Wacker A.-G., Munich; Aluminiumwerk G.m.b.H., Bitterfeld; Elektrochem. Werke Horrem A.-G.; Elektrochem. Werke G.m.b.H., Bitterfeld; Elektro-Nitrum A.-G., Rhina; Soc. Electroquímica de Flix, Barcelona; Ampère G.m.b.H., Berlin; Duisburger Kupferhütte A.-G., Duisburg; and Deutsche Molybdänwerke, Teutschenthal.

From the foregoing it is clear that the I.G. is already a factor to be reckoned with in German electrometallurgical industries. So far no mention has been made in the German Press of the ferrous metals. It is, however, known that the trust has very large interests in coal and fuel, which may, sooner or later, form a connecting link with the iron and steel trades. But altogether apart from this aspect of the matter (important as it is) the extension of the I.G. to the metal industry is likely to have some very important results. As far as actual production is concerned, economies will probably be effected as they have already been in other branches of I.G. activity, that is, by centralisation and prevention of overlapping. It is, however, likely that these recent changes will have their greatest reverberations in the sphere of research. On the purely chemical side, the I.G. probably has the largest research staff in the world. It is formed of men who, both in regard to research and in the application of research results to large scale operations, have a remarkable record of achievement to their credit. The effect of establishing contact between these workers and the corresponding members of the metallurgical industries will probably be far-reaching.

Production of Steel by Direct Methods

CONSIDERABLE work has been done in the past on the production of steel by direct processes, and numerous patents relating to this problem have been granted. The Bureau of Mines, Washington, has made a thorough investigation of the production of sponge iron and the utilisation of this material in the form of pig iron and steel. It is the purpose of an investigation being conducted at the North Central experiment station of the Bureau at Minneapolis to make a survey of all the work that has been done on direct processes and to determine what fundamental information is needed to develop direct methods for making steel. Gaps in the present fund of information will be filled in by laboratory experiments. The Bureau of Mines is particularly interested in the use of non-coking fuel in reduction and the utilisation of low-grade ores by concentration after metallisation has taken place. Although the present supply of good grade iron ore and coking coal seems adequate for the immediate future at least, any development which would utilise a non-coking fuel in connection with the metallisation of low-grade iron ores would open up vast quantities of dormant materials, basic to the manufacture of steel.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

The Foundry Trade Exhibition

To the credit of all concerned, seeing that, in the present conditions of transport, and of trade generally, the difficulties must have been enormous, the Foundry and Allied Trades Exhibition, held a fortnight ago at the Royal Agricultural Hall, passed off with great success, while the attendances at the sessions of the Institute of British Foundrymen were remarkably good. It must be freely admitted that the art of the foundry has languished for many years in this country, and that iron founding has been one of the last of the industries to become informed with the spirit of science. There are evidences that this has now ceased to be so, and that there is a healthy and promising process of scientific "penetration" at work in this, one of the oldest metallurgical arts. The "Technical Non-Commercial Exhibit" attracted very great attention, and the purely commercial exhibits had more than the usual degree of technical interest attaching to them. Amongst the former there were several specimens of what may be called "heat-treated" cast iron. Amongst the latter, the application of oil fuel to cupola practice attracted perhaps the maximum attention of those present. Both are developments of such interest to metallurgists that they deserve further mention.

Heat Treatment of Iron Castings

WHAT is known as heat-treatment has hitherto been very largely confined to steel products. It involves chiefly, of course, the transformations of iron and of iron-carbon compounds, with a view to stereotyping, at some particular temperature, the phases and constituents the mechanical and physical characters of which it is desirable to develop to the utmost. It is only of late years that the principles involved have been applied to cast iron. The pioneer process was that of Lanz, concerning the pros and cons of which, and even the advantages, there have been many acute and even embittered controversies. There are now a number of other processes, which compete with it and with one another. Specimens of pearlitic iron by the Lanz process, by the Emmel Thyssen process, and by the new Mehanite process, with photo-micrographs illustrating their structure, were on view at the Technical Exhibit. The processes may, roughly, be grouped into two: in one category is to be placed those—for there are many others now extant—which aim at developing the requisite composition, texture and properties of the cast iron in the cupola itself, by careful adjustment of the mixtures employed, and the temperature of working, and securing eventually a low carbon cast iron; in the other category are those processes in which the carbon condition is controlled by employing heated moulds, which involves careful adjustments in their size and thickness as well as in the temperatures to which they are preheated. In both cases castings distinctly superior to the older cupola ranges of castings are being successfully produced. Up to now the advantage appears to lie with the "heat-treated" castings, and with methods by which the moulds are brought to the requisite temperatures, as a wider range of mixtures can be employed, and conditions are under better control.

Oil-fuel in Foundry Practice

THE conditions prevailing in the coal trade conspire to favour alternatives, as regards fuel in foundry work, and the most convenient and easily available is oil. It is true that the oil is, of necessity, imported, and that the industry has therefore to rely for its supplies on foreign sources, but when it is a question of depending, as it is at present, upon imported coal and imported oil, dependence on oil would appear to be the lesser of the two evils. In any case it is a substantial fact that many foundries equipped for oil burning are at work to-day, whereas those dependent on coke are in most cases at a standstill. This applies to non-ferrous foundries as well as to iron foundries. In the circumstances it was not, therefore, surprising to find that the Shell-Mex stand at the Exhibition, where demonstrations were daily carried out on the melting of metals in a Monometer tilting furnace, was a centre of attraction. The oil used has, of course, to be low in sulphur. This is a condition not difficult to fulfil; apart from this, oil

has innumerable advantages which render its use in foundries increasingly popular. In some of the demonstrations referred to, 400 lb. of copper were readily melted in 75 minutes, starting from cold, and with an oil consumption of only six gallons by 1,000 lb. of metal. Equally satisfactory results are obtained, with corresponding economy, when iron and steel and other metals constitute the charge.

Magnesium-Aluminium Alloys

THE study of the ternary system aluminium—magnesium—cadmium has been successfully completed by J. Valentin. The alloys have a very real industrial importance and the work done upon them is a substantial contribution to our knowledge of an increasingly important group of materials. Curves have now been published relative to:—

1. Al-MgCd.
2. Cd-Al₂Mg₃.
3. Al₂Mg₃-MgCd.
4. MgCd-AlMg.
5. Cd-AlMg.

The Mg-Cd and the Al-Mg binary compounds have yet to be confirmed but their existence is indicated in the diagrams. That Mg-Cd exists is concluded from the fact that in mixtures which presumably contain this compound only two thermal points are observed instead of three. Moreover, there is some evidence of the existence of a compound corresponding with the formula Al₂Mg₃. It would appear to be homogeneous and highly resistant to corrosion by acids, and thus bears out the observations of Hanson and Gayler. An interesting table of aluminium-rich alloys accompanies the research. This shows, broadly, that as the percentage of magnesium increases, the Brinell hardness number rises. The hardest alloy consists of 91 parts of aluminium and nine parts of magnesium. The influence of the cadmium present is either nil or, at most, insignificant. In the case of the Al₉₃-Mg₇ alloy, the addition of 1 per cent. cadmium has a slight hardening effect. In the magnesium-rich series its effect is equally unimportant. The hardest alloy of this series is one with 88 per cent. magnesium and 12 per cent. aluminium, but no cadmium. The Brinell hardness of this alloy is 65.

Comparative Impact Resistance of Steel in the Cold and when Heated

THE classical work of Dickenson, on the tensile strength of steel at high temperatures, valuable though it is, throws little light on the growingly important question of the variation of the impact resistance of steel at different temperatures. One of the latest investigations of this class of phenomena is the work of Korber and Pomp, carried out at the Kaiser Wilhelm Institute at Dusseldorf. They point out the great need for maintaining constant, during any given determination, the temperature of the test piece, which should be steeped for half an hour at least in water at 20° C. A very small temperature variation will vitiate the results unless such precautions are observed. One of the most interesting points brought out during the investigations is the superior reliability of wrought iron, at low temperatures, owing to its smaller tendency to deformation during forging operations, as compared with steel. In steel, forging increases grain growth, and, therefore, brittleness. In wrought iron, on the other hand, the slag inclusions invariably present have the advantage of preventing the grain growth, by breaking up the crystals in which they occur. This effect is beneficial and renders the material more highly resistant to impact. The impact test on metal at 100°, 200° and 300°, and its comparative difference at 20° constitutes one of the most valuable modes known for determining its suitability where impact stresses are likely to be encountered.

Sir George Beilby Memorial Fund

THE proposal to establish a memorial to the late Sir George Beilby has been under the consideration of a joint committee, consisting of officers of the Institute of Chemistry, the Society of Chemical Industry, and the Institute of Metals. This proposal should make a special appeal to metallurgists, as Sir George Beilby, apart from his work on chemical subjects and fuel economy, contributed notably to the advance of

certain aspects of metallurgy, especially in regard to the microstructure and physical properties of solids in various states of aggregation. The committee appeals for contributions to a fund of not less than £5,000. From the interest on this capital, at intervals to be determined by the administrators, who shall be representatives of the three institutions, substantial awards will be made to British investigators in science to mark appreciation of records of distinguished original work. Preference will be given to investigations relating to the special interests of Sir George Beilby, including problems connected with fuel economy, chemical engineering, and metallurgy. The committee desires to emphasise that the proposal does not imply an award on the result of a competition in respect of work on a prescribed theme, or the solution of a definite scientific problem; but the recognition of continuous work of exceptional merit, bearing evidence of distinct advance in knowledge and practice. The committee requests that all contributions may be made payable to the Beilby Memorial Fund, and cheques, postal orders, etc., crossed "Westminster Bank." Communications should be addressed to the Hon. Secretaries, Sir George Beilby Memorial Committee, 30, Russell Square, London, W.C.1. Up to the present the contributions total £1,762 12s. 3d.

National Trusts: International Agreements

REPORTS from abroad indicate that there is "something doing" in the iron and steel world. In the first place it appears that the movement for the "trustification" of German industry is proceeding apace. On another page an account is given of the unification which is taking place in the German non-ferrous metal industry, under the aegis of the I.G. Independently of this (as far as is known at present) a similar movement is occurring among the ferrous metal manufacturers. A Consolidated Steel Trust has been formed in Germany, in which the mining property of the following companies has been merged: The Bochum Mining and Cast Steel Co., the German Luxembourg Mining and Smelting Co., the Gelsenkirchen Mining Co. (with the exception of the Monopol Mine), and the Phoenix Mining and Smelting Co. The trust is to become a member of the Rhenish Westphalian Coal Syndicate, and a sales organisation is being formed for the Trust and the Syndicate jointly. Reports have also been current of the granting to the Trust, by Dillon, Reed and Co. of New York, of a loan of \$35,000,000 (£6,000,000) in the form of 6½ per cent. bonds, and according to the latest information from New York, these bonds (described as being offered on behalf of the United Steel Works of Germany) have been oversubscribed. The bonds are to run for 25 years, and were issued at 96, yielding a return of 6·83 per cent. Concurrently with these developments, it is announced that a Central European iron and steel alliance is to be concluded. The German, Austrian and Czecho-Slovakian interests are to be linked up, following on an agreement which is about to be made between the Czecho-Slovakian iron industry and the Austrian Alpine Montangesellschaft. The Central European alliance, which will compete with the Franco-Belgian combine, will be dominated by the German Steel Trust. It may be added that an Iron Tube Trust has been established between the German, French, and Belgian Saar industries.

It is early yet to realise the effect of these movements on the British iron and steel trade, but it is difficult to repress a feeling of uneasiness. It is to be hoped that manufacturers in this country, in the unwelcome leisure thrust upon them by the coal strike, will ponder deeply the momentous events which are occurring abroad, with a view to taking, at the earliest possible moment, such steps as may be necessary for the defence of a vital British industry.

Use of Broken Silica Tubes

WE have received the following inquiry from Joseph Rodgers and Sons, Ltd., of Sheffield: "In following the Monthly Metallurgical Section of your paper, we have not seen any suggestions as to putting to use broken silica tubes. As you know, these tubes are expensive, and it seems a great waste to have to throw one on the scrap heap, due to a small crack or a clean break. Surely you have, or some of your readers, an idea by which these broken tubes may be put to some useful purpose, as we find that the discarded tubes accumulate in an alarming manner, the ones used in the estimation of carbon being the worst offenders."

"F" Steel

FURTHER information has appeared in the German press and elsewhere in regard to this steel. Examination of the steel indicates 0·67 to 1·1 per cent. of silicon and 0·10 to 0·14 of carbon. As compared with a simple carbon steel, there is an increased elastic limit and breaking strength, while the ductility is not reduced. According to a note in *Nature* the steel is not a new one, but is a high-silicon alloy of a kind already known to metallurgists. Sir Robert Hadfield, in his book on *Metallurgy and its Influence on Modern Progress*, describes the use of a similar steel having a rather higher carbon content in the construction of the *Mauretania* and the *Lusitania*. These steels were introduced into shipbuilding by the late Mr. John Spencer, the composition having been worked out as a result of the investigations of Sir Robert Hadfield on silicon steels.

A French Book on Steels

WE have received a copy of *Trempe, Recuit, Cémentation et conditions d'emploi Des Aciers* (The Tempering, Annealing, Cementation, and Conditions of Use of Steels), by L. Grenet, Ingénieur civil des Mines (Third edition, revised and enlarged. Paris and Liège: Librairie Polytechnique Ch. Béranger. Pp. 657). The book is divided into five parts. Part one deals with points important in the use and heat treatment of steels, including chapters on the numerical coefficients defining a steel; the equilibrium of the constituents of carbon steels as a function of the temperature; the constitution of steels containing important proportions of elements other than iron and carbon; the classification of steels according to the temperature of transformation on chilling; effect of heat treatment on the properties of steels; and the heat treatment of steels. Part two deals with steel treating processes, including chapters on the effect of the state of the steel on subsequent treatment; the treatment of steels considered generally; cementation; the four classes of steel and their properties as a function of heat treatment; and the definition and study of steels. Part three deals with the choice of a steel, including chapters on determining causes in the choice of a constructional steel; a discussion of formulae for the strength of materials, specially applicable to steel structures. Part four deals with the study of different steels, including chapters on steels of the first class, carbon steels; special steels of the first and second classes; special steels of the third class; and steels of the fourth class. The fifth part deals with cast steel, cast iron, and non-ferrous alloys, and also includes chapters on bronzes, brasses, and light and ultra-light alloys. The text is illustrated by a number of micro-photographs and diagrams.

Desirable Properties in Furnace Sand

A REPORT on "Special Sands," by W. M. Weigal, has been published by the U.S. Bureau of Mines. In fire or furnace sand (the silica or sand used to line furnace bottoms and walls, especially in those furnaces making acid open hearth steel) a high silica content is essential, and such sand is usually called "silica sand." A small amount of bonding material is required to hold the sand in place until it has been fired or "burned in." If the sand is so pure as to be lacking in any bonding property, some bond, such as a plastic fire clay, is usually added. Many sands used for this purpose have sufficient natural bond in the form of silicates and iron oxide, usually present as limonite. A sand graded from coarse to fine is used. A small amount of fine material is desirable, as it assists in bonding, fills voids between the larger grains and makes a more impervious hearth. Also, the finer grains sinter more rapidly when firing the new hearth. Prepared, screened sands are often used, in which there are no large grains. Apparently, however, large pieces are not objectionable in all cases, as some producers market a crushed sandstone which has passed a 2 mesh screen (about ¾ in.).

Chemical analysis is important as affecting the refractoriness of the sand. Alkalis should be at a minimum. This eliminates sands containing much feldspar and mica. Clay is the best bond and the least objectionable impurity. Small amounts of iron oxide are not objectionable and probably play an important part in the bond. As low as 80 per cent. silica sands have been used in extreme cases, but a silica content in excess of 95 per cent. is usually specified.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

ANOTHER month has passed, and we are so much nearer to the termination of the coal dispute, but the actual settlement seems to be as uncertain as ever. There is apparently no desire to get to grips and find a way out of the *impasse*. In the meantime the stoppage is tightening the strangle-hold on the industry of the country, particularly the iron and steel section. Here and there one finds a blast furnace at work, but this is generally for the purpose of maintaining the supply of electricity for the surrounding community. Some of the finishing trades are able to carry on with their stocks of raw material, but the productive side of the industry is practically at a standstill, and will remain so until the collieries are once more working and regular supplies of coal are assured.

Steel from the Continent

More attention is now being given to supplies of steel from the Continent. There are a number of the smaller works engaged on special products which have still sufficient stocks of coal to carry them on for some weeks if they can get supplies of semi-finished steel, billets, etc. As the British works are unable to give deliveries, the only alternative is to shut down or to use foreign material. The stocks held by the works at home have been extensively drawn upon, and of billets, which are the principal need of the finishing trades, there can be very little left. It is not surprising, therefore, that there has been an increased demand for continental billets, and the price has already advanced. The quantity coming from abroad has not been very large, as there is still a cautious spirit on the part of the buyers, who do not wish to commit themselves too far ahead for foreign supplies. There is always the hope that some unexpected development may occur which will result in the reopening of the collieries. In some instances foreign coal has been purchased, and fair quantities have been brought to the East Coast ports and to Manchester, but the use of this coal is limited, as the price is prohibitive, ranging from 40s. to 52s. delivered to works here; moreover the quality is inferior. The coal may do for some of the lighter trades which manufacture high-priced goods, but it is no use for the heavy industries, as the increase in production costs would be far too great. For these works there is no other course open than to wait as patiently as possible for a settlement.

The Eight-hour Day

The decision of the Government to bring in a Bill to permit an eight-hour day in the collieries has somewhat disturbed the miners' leaders. The proposal is that for a period of five years the collieries shall be free to work eight hours per day if they wish, and while it cannot compel the men to work the extended hours, it leaves them free to do so if the owners and the men are in agreement on this point. In any case the owners will not depart from their demand for a reduction in wages or for longer hours, and it is for the miners to say which they will have. The proposed measure will leave the choice open, and it may lead the way to a resumption of work, as it is no secret that there are collieries at which the men would be willing to work the extra hour at the same rate of pay as before. A temporary reduction in wages is regarded as inevitable, whether it comes in the shape of a lower rate of wages or longer working hours. It seems to be no use trying to point out that such a condition may be only of short duration. If the collieries can resume work on a basis that will enable them to produce coal at a reasonable cost, it may usher in a period of prosperity not for the coal trade alone, but for all the other industries dependent on it, and the time would soon come when an advance in wages would be assured; and it would be criminal on the part of the owners not to give the advance at the earliest moment that the state of the trade justifies it. The pressing matter at the moment is to convince the men, through their leaders, that some sacrifice on their part is inevitable, and when that fact has been accepted we shall see the collieries starting up again, probably on district agreements.

Increased Cost of Production

It appears to be the general opinion in the steel trade that when work is resumed there will be an increase in the cost of production. Already the associated iron and steel makers

have unofficially increased the price of all classes of steel for forward sales. A meeting was held in London recently to consider this proposal, and whilst no official advance in price was made, it was suggested that the individual members should increase their prices 5s. per ton all round, and that suggestion is being acted upon. There was a fear that an official advance might react unfavourably on the present labour dispute and give the miners further argument for holding out. That view might be correct if steel selling prices were in the right proportion to the costs of production, but even the advance of 5s. will not bridge the margin which already exists on the wrong side, and it is folly to think that the steel makers can go on supplying steel at a loss when the present dispute is settled. There must be more than one works in a precarious condition owing to the long continuance of that policy, and now there have to be faced the huge losses which have accrued and are still mounting up as a result of the stoppage. It is difficult to see what harm would be done by an official advance in price, and such a step will have to be taken in the near future. However, a further meeting of the makers is to be held about the middle of July, and it will be interesting to see what decision is then taken.

Dearer Coal

Bearing on this question, the resolution passed at the annual meeting of the National Federation of Iron and Steel Manufacturers on June 17 is worthy of note. The resolution, which was forwarded to the Prime Minister, points out the important part which coal plays in the iron and steel industry, and that it is essential that any settlement of the crisis should not impose further burdens on it; further, that any increase in the price of coal must reduce still further the competitive power of the industry, which would react unfavourably on the coal trade. The spirit of the resolution is good, but it is unfortunately probable that the fear on which it is based will be realised. One of the leading coal owners has given it as his firm opinion that coal prices will be considerably higher when work is resumed, and he is probably correct. There is not only the intention of the coal owners to cease incurring losses but also the fact that the brisk demand for supplies when the works reopen will strengthen their hands. There will be a large accumulation of work to be cleared off; indeed some of the steel works have a much better order book now than when they stopped, particularly for home consumption, and there is every prospect of activity for a little while. If the coal settlement is one that carries with it the promise of a prolonged period of peace, this send-off may easily develop into a steady revival in the steel trade.

Heavy Company Losses

At present one cannot lose sight of the depressing state of affairs which is revealed by the published accounts of some of the larger of the iron and steel works. The disastrous result of Armstrong, Whitworth and Co.'s operations caused a sensation, and since then we have had the reports of the Consett Iron Co. and the Ebbw Vale Co., both of which told the same tale of heavy losses. Similar results are expected from other quarters. These figures bring home once more the lesson that output and the getting of orders are not the only considerations, and that it is often better to be satisfied with a restricted output at reasonable prices.

The effect of the coal stoppage on the iron and steel trade can be judged from the production figures for May. Out of the 147 furnaces which were in blast at the end of April only 23 remained in operation at the end of May, and that number will probably be reduced in the June figures. The output of pig iron fell from 539,100 tons in April to 88,800 tons in May, and the production of steel from 661,000 tons to 45,700 tons.

Technical Service

WE have received from Keighley Laboratories, Ltd., metallurgists and consultants, of Croft House, South Street, Keighley, a series of four cards illustrating the service they offer. Any firm interested can obtain a similar set on application to the Laboratories.

Some Inventions of the Month By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Treating Copper Ores

A PROCESS has been patented by J. C. Moulden, B. Taplin, and Metals Production, Ltd., of London, for the concentration of oxidised copper ores, e.g., chrysocolla, malachite, azurite, cuprite, melaconite, to render the copper readily recoverable. The ore is mixed with solid carbonaceous matter and is heated in presence of a halogen to a temperature of about 700° C., when it is found that the copper appears to migrate from the ore particles, and is found outside them. Preferably the ore and solid fuel are mixed with common salt and passed continuously through a heated zone at a low red heat in a neutral atmosphere. The product is cooled in a non-oxidising atmosphere, and is then leached with an ammoniacal solvent to extract the copper. See Patent No. 250,991, dated October 29, 1924, November 27, 1924, and April 3, 1925.

Concentrating Ores

In a process for concentrating ores, etc., by froth flotation, patented by Ellis Flotation Co., Inc., of New York, the ore pulp is mixed with a modifying agent to coat the mineral particles and then aerated to form a froth by means of a gas containing more than 25 per cent. and preferably more than 40 per cent. of oxygen. The gas may also contain ozone. See Patent No. 251,171, dated October 12, 1925.

Titanium, Tungsten and Tantalum

ACCORDING to a patent by A. W. Gregory, of London, an ore such as ilmenite, wolframite, or tantalite is given a preliminary treatment by mixing with carbon and sodium carbonate and heating to bright redness in a closed vessel or in a reducing or neutral atmosphere. The mass is then treated with 2 per cent. sulphuric acid, which removes practically the whole of the iron. The residue contains practically the whole of the titanium, tungsten, or tantalum, and is then treated by known means for the recovery of these.

Separating Antimony and Lead

RELATIVELY pure antimony is separated from lead bullion containing more than 7 per cent. of antimony by melting the lead to a bright red heat in an oxidising atmosphere. The tin is first oxidised and is skimmed off and the antimony is then separated as a fume of antimony oxide. The formation of litharge and antimony dross is limited. Any litharge reacts with the antimony in the bath to form antimony oxide. The residue of antimony forms a dross which is skimmed off. Copper separates as a dross on cooling. See Patent No. 251,736 (American Smelting and Refining Co. of New York), dated March 17, 1925.

Tungsten Carbide Alloys

A PATENT by the General Electric Co., Ltd., of London, describes the manufacture of a sintered hard alloy for tools consisting principally of tungsten mono-carbide, which during carbonisation is heated so that the small particles adhere only loosely, and which contains 10-20 per cent. of a metal of lower melting point such as iron, cobalt or nickel. See Patent No. 251,929, having the International Convention date, May 7, 1925.

Metals and Alloys

ACCORDING to a patent by D. Croese, of The Hague, Holland, titaniferous ironsand is caused to fall vertically through an electric furnace so that it passes through a number of electric arcs in succession. The ironsand is reduced and the metal is collected in a crucible at the bottom. By continued heating the titanium content of the alloy can be reduced to less than 1 per cent., thus producing titanium steel. See Patent No. 252,455, dated February 26, 1925.

Standardisation of Steel Pipes

MANUFACTURERS, distributors and users, at a conference held at Washington with officials of the Division of Simplified Practice, United States Department of Commerce, approved the adoption of a curtailed list of standard sizes and the elimination of little-used sizes of wrought iron and wrought steel pipe, valves, and pipe fittings. The meeting eliminated 762 specified sizes of valves and fittings and 18 sizes of pipe.

The Canadian Metal Industry Iron and Steel

ACCORDING to a preliminary statement issued by the Dominion Bureau of Statistics of Canada, production of iron and steel and their products in Canada in 1925 amounted in value to \$378,434,934, an increase of 8.5 million dollars over the output value of \$370,088,674 shown for 1924. The 1,052 active plants represented a capital investment of 538 million dollars and gave employment to an average of 77,014 persons throughout the year. Expenditures for salaries and wages totalled \$100,258,567. Sales of pig iron, steel ingots, steel castings, and rolled iron and steel products totalled \$37,884,411, an increase of 4.3 million dollars over the corresponding figure for 1924; sheet metal products were worth 4 million dollars more than in 1924; hardware and tools advanced 3 million dollars in value; automobile production increased 22.4 million dollars to a value of \$110,835,380 and the number of 161,970 cars was the highest on record for the industry; the production of industrial, office and household machinery was up 1.5 million dollars; the wire and wire goods industry showed a similar increase; the boilers, tanks and engines industry and the miscellaneous iron and steel products group reported appreciable gains, and the agricultural implement group maintained the same rate of production as in 1924. There was a general reduction in the outputs from the plants producing railway rolling stock. Imports into Canada of iron and steel and their products during the calendar year were valued at \$166,573,076, as compared with \$137,979,471 in 1924. Of this total 86 per cent. came from the United States and 11 per cent. from the United Kingdom. Exports totalled \$69,356,468, of which 11.3 per cent. went to the United Kingdom, 9.7 per cent. to the United States, and 79 per cent. to other countries. Automobiles and parts at \$39,417,614 made up 57 per cent. of Canada's exports of iron, steel and their products.

Non-Ferrous Metals

The Dominion Bureau of Statistics at Ottawa has just forwarded to the High Commissioner for Canada in London a preliminary statement on the manufactures of the non-ferrous metals in Canada during the calendar year 1925, from which it appears that the value of last year's output reached \$104,167,459, which is three million dollars in excess of the value attained in 1920, when the previous record for this group of industries was reached. Plants in operation numbered 377 in 1925 as compared with 341 in the preceding year; capital employed totalled \$120,806,561 as against \$114,354,971 in 1924; the average number of employees was 22,933 as against 21,670; and salaries and wages totalled \$27,518,997, an increase of nearly 1.5 million dollars over 1924. Production of aluminium metal and aluminium were amounted in value to \$9,162,046, an increase of 1.4 million dollars over 1924; the 12 firms in this industry represented a capital investment of over 9 million dollars and gave employment to 1,161 persons throughout the year. Brass and copper products such as castings, bars, sheets, rods, valves, cable, etc., reached a total value of \$19,336,251 as compared with a value of \$15,487,826 in the preceding year; 93 plants operated in this industry in 1925 and employees numbered 4,055. The lead, tin, and zinc products industry with 21 plants employed a capital of over 3.7 million dollars and reported a production worth \$3,787,283, an increase of nearly half a million dollars over 1924. Precious metal products including jewellery, silverware, dental gold, etc., were valued at \$9,603,983; the 110 establishments gave employment to 2,589 and paid out \$3,438,330 in wages and salaries. Electrical apparatus and supplies at \$61,276,848 reached a new high value for the industry and was 5 million dollars above the figure for 1924. Miscellaneous non-ferrous metal goods including lamps, lanterns, weather stripping, etc., reached a total value of \$1,001,048, as compared with \$741,066 in the preceding year. Imports into Canada of non-ferrous metal goods reached a total value of \$46,677,309, or about 5 million dollars above the corresponding figure for 1924. United States supplied \$38,035,443 worth, or 81 per cent., of Canada's imports of this class. Exports amounted in value to \$103,709,496, as compared with \$84,780,015 in 1924. Shipments to the United States totalled \$64,872,593, and \$17,770,420 worth went to the United Kingdom.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Contribution to the study of ternary alloys. J. Valentin. *Rev. Métallurgie*; Part I, April, 1926, pp. 209-218; Part II, May, 1926, pp. 295-314 (in French). Principally a study of the system aluminium-magnesium-cadmium.

Equilibrium diagrams and their industrial importance. P. Herrent. *Bull. Fed. Ind. Chim. Belg.*; Part I, March, 1926, pp. 123-135; Part II, April, 1926, pp. 181-189 (in French). A discussion of the theory of alloys.

The improvement process in aluminium alloys. W. Fraenkel. *Z. Metallkunde*, June, 1926, pp. 189-192 (in German). A study of the change in electrical conductivity during the process.

ANALYSIS.—The determination of aluminium oxide in aluminium metal. W. H. Withey and H. E. Millar. *J.S.C.I.*, June 4, 1926, pp. 170-174.

Analysis of boron alloys. N. Tschischewski. *J. Ind. Eng. Chem.*, June, 1926, pp. 607-608.

FURNACES.—Cyanide accumulation in the blast furnace. Part II. R. Franchot. *Blast Furnace and Steel Plant*, June, 1926, pp. 254-256.

GENERAL.—Non-ferrous metallography. Part I. J. S. E. Primrose. *Metal Ind. (Lond.)*, June 18, 1926, pp. 569-573.

The production of single crystals of metals and some of their properties. H. C. H. Carpenter. *Metal Ind. (Lond.)*; Part I, June 11, 1926, pp. 543-546; Part II, June 18, 1926, pp. 575-576.

IRON AND STEEL.—The hardening of steel: a review and some comments. Part III. W. T. Griffiths. *Metallurgist*, May 28, 1926, pp. 72-74. Deals with troostite, martensite and austenite.

Some characteristics of quenching curves. H. J. French and O. Z. Klopsch. *Trans. Amer. Soc. Steel Treating*, June, 1926, pp. 857-878. A discussion of time-temperature cooling curves of quenched steel samples.

The distribution of silicates in steel ingots. J. H. S. Dickenson. *Engineering*, May 28, 1926, pp. 640-641.

Graphitisation at constant temperature. H. A. Schwartz. *Trans. Amer. Soc. Steel Treating*, June, 1926, pp. 883-906. A mathematical analysis of the data; includes a laboratory method for determining the graphitising rate.

The effect of mass in the heat treatment of nickel steel. W. Rosenhain, R. G. Batson and N. P. Tucker. *Engineering*, June 11, 1926, pp. 705-707.

Facts and principles concerning steel and heat treatment. Part VII. H. B. Knowlton. *Trans. Amer. Soc. Steel Treating*, June, 1926, pp. 954-965. Discusses methods for producing a variation in the physical properties of different parts of the same steel.

Electrolytic iron from ilmenite ores. R. H. Monk and R. J. Traill. *Canad. Chem. Met.*, June, 1926, pp. 137-139.

Irregular carburisation of iron and iron alloys—the cause and prevention. W. J. Merten. *Trans. Amer. Soc. Steel Treating*, June, 1926, pp. 907-919.

Progressive carburisation in rotary electric furnaces. H. E. Martin. *Trans. Amer. Soc. Steel Treating*, June, 1926, pp. 933-937.

General principles of the beneficiation of iron ores. Part II. T. T. Read. *Blast Furnace and Steel Plant*, June, 1926, pp. 265-273. An economic discussion of the extraction of iron from various ores.

LEAD.—Lead refining by the Harris method. A. S. Schott. *Metall u. Erz.*, June (1), 1926, pp. 306-315 (in German). An illustrated account of the refining of lead by means of salts.

Present tendencies in smelting and leaching lead ores. R. C. Canby. *Mining and Met.*, June, 1926, pp. 249-253.

NICKEL.—Nickel and the metal industries. P. D. Merica. *Metal Ind. (N. York)*, June, 1926, pp. 238-241.

Development of the use of nickel in the plating shop, brass foundry and general industry.

ZINC.—The present-day position of the electrolytic winning of zinc. G. Eger. *Metall u. Erz.*, June (1), 1926, pp. 316-325 (in German).

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

HENDY HEMATITE IRON ORE CO., LTD., Pontypridd. Registered May 25, £500 debentures, part of £10,000; general charge. *£3,859. July 24, 1924.

ITABIRA IRON ORE CO., LTD., London, E.C. Registered June 10, £20,000 further charge, supplemental to mortgage dated March 2, 1916, and transfers and further charges dated October 7, 1918, and December 7, 1918, securing £270,000 and further advances, to Brazilian Investment Syndicate, Ltd., 81, Gracechurch Street, E.C.; charged on premises charged by original mort. *£515,589 4s. 7d. Dec. 31, 1925.

PEARSON AND KNOWLES COAL AND IRON CO., LTD., Warrington. Registered June 15, £550,000 debentures, to Westminster Bank Ltd.; general charge, excluding any shares and investments held by the company or its nominees in certain companies. *£1,000,000. October 13, 1925.

Satisfactions

BLAENAVON CO., LTD., ironmasters. Satisfaction registered June 12, £2,800, part of amount registered August 24, 1911.

DARWIN AND MILNER, LTD., Sheffield, steel merchants. Satisfaction registered June 16, £25,000 (not ex.), registered September 18, 1914.

SPARTAN STEEL CO., LTD., Sheffield. Satisfaction registered June 16, £25,000 (not ex.), registered September 18, 1914.

SYBRY, SEALS AND CO., LTD., Sheffield, steel manufacturers. Satisfactions registered June 16, £3,953 4s. 6d., outstanding July 1, 1908; £5,000 (not ex.), registered November 16, 1903; and £8,000 (not ex.), registered April 26, 1909.

Metallurgical Matters in Parliament

Local Rates and Taxes

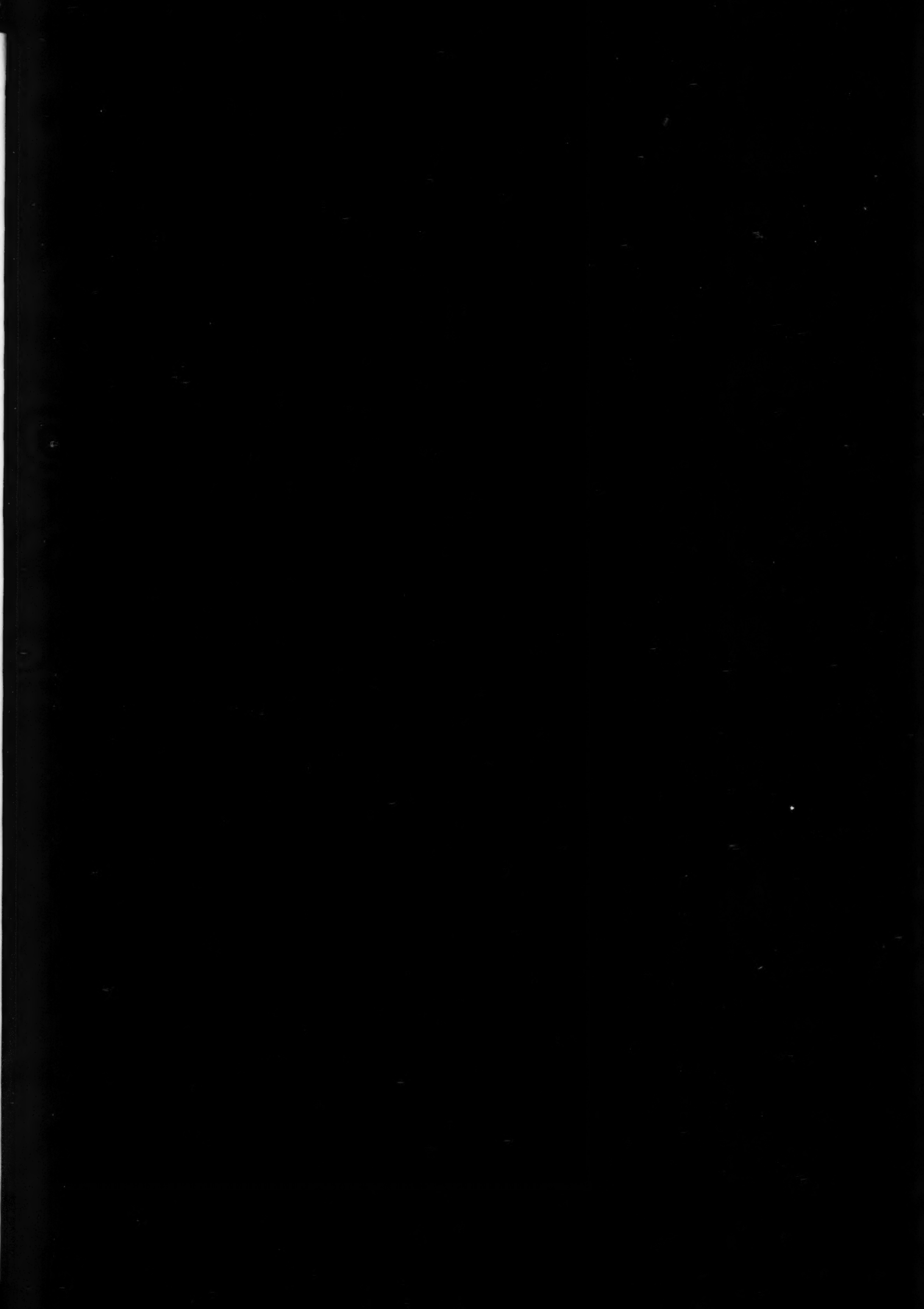
Sir Wilfrid Sugden (House of Commons, June 28) asked the Prime Minister if, in view of the stagnation in the steel- and iron-rolling industry, as also in the shipbuilding trade and in respect of pig iron production, he would consider the bearing of local rates and taxes upon such cost of production, with a view to assisting such employers who were prepared to continue their production without profit or at the minimum profit?

Sir Burton Chadwick, replying for the Prime Minister, said that his attention had been called to the effect of local taxation on the cost of production in the iron and steel industry. With regard to assistance to that industry, he would refer Sir Wilfrid Sugden to the answers given by the Prime Minister to other members on February 24 and December 21.

Sir W. Sugden asked whether, bearing in mind the fact that since those answers had been given the position had become rapidly worse, would a conference of those concerned be called in order to deal with the present position?

Sir B. Chadwick answered that the Prime Minister made his statement of policy in answering the earlier questions. The returns since April had been improving.

Sir W. Sugden asked if it were not a fact that, if any arrangement for a cheapening of the municipal loan could be provided by the Government, it would have the definite effect of giving employment to those who were concerned in these three hardly-pressed industries, by reason of the fact that rates would be reduced?



Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

The Origin and Nature of Liquefaction in Alloys

A Review of Recent Investigations and Theories

FOR many years the phenomenon of segregation in castings has been known, and has been popularly thought to embrace principally the accumulation of impurities in the portions of an ingot or casting which solidify last. Thus, for instance, in a large steel ingot, the central area, merging into the pipe towards the top, is known to be unsound and impure, and various steps have been taken by risers, dozzles, etc., to ensure that the main body of metal shall be as unaffected as possible.

The phenomenon of liquation, on the other hand, is of a somewhat different nature, though the line of distinction is perhaps a little obscure. It has reference to another widely observed series of facts which, in a general way, may be described as the concentration of the main constituents of an alloy in a constant and regular fashion depending on the composition and the characteristics of casting. It has been found, moreover, that liquation often occurs in a manner directly opposite to that which might be expected, a process which in the conflict of ideas came to be known as "inverse segregation," but which may truly be defined simply as liquation—or, if it be preferred, anomalous liquation. The principles underlying the latter have recently been the subject of several interesting investigations, and though the problem cannot, by any means, be thought to be solved, a definite step forward has undoubtedly been taken. The obtaining of a truly representative sample of base bullion has long been recognised as exhibiting certain intrinsic difficulties owing to the liquation of one of the constituents to the outside or the inside of the ingot. Extensive investigations were made by Claudet and others in the concentration of precious metals in lead bars, and they found considerable variations, depending on the amounts of the second constituents present. Various expedients have since been adopted to overcome these natural difficulties in sampling commercial alloys. Little progress, however, was made in explaining the phenomena which had been found to occur.

Liquation and the Soret Effect

Professor Carl Benedicks* has been one of the first to reopen the subject, and points out, as a result of his researches, that liquation in alloys appears to be identical with the Soret effect in ordinary aqueous solutions. This effect was first referred to by Ludwig in 1856 and has been repeatedly referred to in books since published—by Ostwald, Nernst, van 't Hoff, and others—but has not perhaps received the attention which it deserved. Ludwig showed that when the parts of a homogeneous liquid are at different temperatures a change in the distribution of the dissolved substance occurs, the greater concentration occurring in the colder part. Benedicks investigated the distribution of carbon in iron and steel and observed a concentration of that element towards the cooler portions which was apparently contrary to the heterogeneous equilibrium diagram. This he attributes to the operation of the Soret effect in molten iron and steel.

Dr. S. W. Smith† has also investigated the liquation phenomena from the point of view of non-ferrous alloys, and has made interesting and very suggestive speculations, based on his previous inferences, as to the probable origin of ore bodies in nature. Smith studied the alloys of silver-copper, gold-copper, and silver-gold-copper, and evolved the working hypothesis that that constituent liquates towards the cooling surface which, if added in further quantity to a mass of the

particular composition, would lower its freezing point. The conditions under which the occurrence is most pronounced are mainly two: (1) a steep temperature gradient from the chilling surface of the mould to the central portions of the mass; and (2) a temperature range or solidification interval between the commencement and completion of solidification. It is suggested that there is a potentiality towards differentiation in alloys in the liquid state and that a difference in physical properties—surface tension, atomic volume, and intrinsic pressure—of the constituents determines the extent of the liquation, under the influence of a temperature gradient, before solidification actually commences. Actual differences in concentration in widely separated parts of molten alloys have not yet been confirmed to any great extent, and the expansion of the theory awaits more conclusive experimental evidence.

The Recent Report

The most recently published work on heterogeneity is contained in the report contributed to the last meeting of the Iron and Steel Institute, by a specially constituted sub-committee.‡ The method of investigation adopted was to cut steel ingots of various sizes up to 170 tons in weight, into two parts, and then observe the physical and chemical characteristics of the sections. An attempt has been made to visualise the mechanism of freezing, and it is shown that all ingots, irrespective of size, exhibit segregation of certain elements in well-defined zones. The degree of segregation is highest for carbon, phosphorus and sulphur, and is almost negligible in the cases of manganese and silicon. Sulphur, moreover, appears to be differentiated according to a different physical law from that which obtains in the case of the other elements. The greater the diameter of the ingot the slower is the rate of cooling and the more marked are the differences in composition observable. The authors draw attention to the analogy with the Soret effect in aqueous solutions, and observe that the rate of liquation will depend on temperature gradients as well as upon actual temperature differences and the character of the constituents. The concrete divisions which have been identified are: (1) a thin outer skin consisting of true chill crystals of ill-defined structure; (2) from this a larger growth of columnar crystals extending inwards, their size depending on the conditions of pouring and the composition of the steel; (3) an annular area richer in segregates and whose shape approximates to that of a truncated cone or pyramid; and (4) a central zone in which the carbon, sulphur and phosphorus are low in the lower half, and in the upper portion of which is a region of extreme segregation.

The Views of Dickenson

A paper by Dickenson§ points out the unique migration of silicate particles within a freezing steel ingot. In perfectly deoxidised steel the percentage of slaggy matter in the form of small globular silicate particles rises to a maximum in the central lower part where carbon, sulphur, and phosphorus are reduced to a minimum. This author considers that this special concentration of silicates is brought about by a heavy rain of crystallites on the rising solid floor of the ingot, which tends to arrest and carry down the coalesced slaggy particles. It is probable that Rosenhain's suggestion that silicon is oxidised during the pouring of the ingot is somewhat nearer the truth.

The above brief summary of work carried out within the last

* Trans. Amer. Inst. Min. Eng., April, 1925.

† Trans. Inst. Min. Met., 1926, Bull. 257, et seq.

‡ May, 1926.

§ Iron and Steel Institute, May, 1926.

few years indicates the searching investigations which are now being made into molecular workings in solidifying metal. The solution of the many problems involved will undoubtedly bring in its train attempts at corrective measures, but to what extent the forces which induce liquation are controllable is still unknown. Smith's hypothesis appears to be universal, though there is some doubt as to how it may be applied in the

case of a metal, such as bismuth, which expands on solidification. Masing, Hanson, and several others have evolved theories depending on the differential growth of crystals along certain axes, and on the withdrawal of one of the constituents in a melt by the crystals enlarging from the cool surface. None of these is very satisfying and demands a good deal from the imagination.

Some New Chemically Resistant Steels Needs of High and Low Temperature Plant

*During the Congress of Chemists held recently in London a paper on "Chemically Resistant Steels—With Special Reference to Very High and Very Low Temperatures" was read by Mr. T. G. Elliot and Mr. G. B. Willey.
We give below some of the more important points raised in the paper.*

THE increasing severity of the conditions required to be met in the chemical engineering industries is placing greater and greater responsibility on the shoulders of the metallurgist, as well as the chemical engineer. This is true of many typical processes in chemical manufacture, as, for instance, digestion, evaporation, lixiviation, filtration, and so on, for the tendency is towards the centralisation of manufacture in larger units capable of high outputs. There is also involved the use of complicated mechanical arrangements to an enhanced degree, calling for materials which will withstand chemical action, extremes of high and low temperature, or high pressures.

High Temperature Steels

That this is true will be readily appreciated on considering the various processes for the production of synthetic ammonia. In the Haber process it is stated that the pressure is 200 atm., the temperature about 600° C., whilst in the Claude process the pressure is said to be about 900 atm., and the temperature about 550° C. The synthetic production of fuel oils from gases, and the hydrogenation of solid fuel, are also problems, the ultimately successful solution of which must depend upon the provision of satisfactory containing vessels. Such conditions obviously demand material of a character quite distinct from that used in the construction of apparatus working at ordinary temperatures and pressures. The phenomenon of heat-scaling provides another example of the urgent call for new materials, and particularly for those possessing resistance to chemical action, necessarily intensified by reason of the high temperatures involved.

In addition to what may be termed chemical inertia, the prevailing condition of high temperature in these applications requires material which maintains the same physico-chemical constitution, and therefore the same type of metallographic structure, at all temperatures within the range of the operations to be carried out. It is well known that ordinary steel and many useful alloy steels undergo changes of structure on heating and on cooling again, and such changes always involve marked alteration in volume. From the fact that in each case a change occurs at some definite temperature, and that during heating or cooling every part of a structure is not at the critical temperature at the same instant, it follows that severe internal stress must be produced, often accompanied by considerable distortion, thus causing weakness. Material possessing in the cold an austenitic micro-structure, and consisting therefore of microscopically homogeneous grains, is thus useful for high temperature work, because whilst this comparative homogeneity is characteristic of most ferrous alloys at high temperatures, many of them at the critical temperature referred to develop a heterogeneous structure on cooling down, due to recrystallisation and the separation of certain constituents. Alloys possessing no critical temperature, and therefore undergoing no change, on heating or cooling again, that is solid solutions, true alloys in fact, are desirable for use at high temperatures. No deterioration in mechanical properties or other alteration takes place during even long exposure to high temperatures, provided that the material possesses the appropriate chemical properties, as is the case in the special alloys to be described.

Development of Special Steels

As a result of extensive research work under the direction of Sir Robert Hadfield, F.R.S., it is now possible to provide steels capable of meeting a great variety of the conditions

specially associated with high temperature work. Table I contains particulars of the mechanical properties of the different types of special alloys described in this paper.

The malleability and ductility of ERA/C.R. material should be noticed; an elongation of 75 per cent. (on 2 in.) and 70 per cent. reduction in area is remarkable.

TABLE I.
Mechanical properties of the various special steels of the types described.

Type.	Yield point. Tons per sq. in.	Maximum stress. Tons per sq. in.	Elongation. Per cent.	Reduction of area. Per cent.	Brinell hardness.
ERA/H.R.	38	58.5	37.5	52	260
HECLA/A.T.V.	24	46	31	51	190
ERA/A.T.V.	26	49	32	49	220
HECLA/A.M.F.	29	47	36	56	200
ERA/C.R. { A.	27	52	45	55	230
B.	15	41	75	70	150

* "A" General engineering purposes; "B" Fully softened condition.

Thus a heat-resisting steel known as Era/H.R., in addition to very marked non-scaling qualities, offers great resistance to corrosive gases and fumes, and possesses great strength at high temperatures. It is well known that at about 800–900° C. ordinary steels lose practically all their strength, becoming incapable of supporting continuously the slightest load, and in fact will sag under their own weight. The value of the special steel at once becomes evident. It possesses when tested in the ordinary way a tenacity of 19 tons per sq. in. at a temperature of 900° C., while at 700° C. its tensile strength is 31 tons per sq. in., equal to that of good mild steel in the cold and with similar ductility. The strength of materials at high temperatures is best shown by the load which they can sustain continuously, and results obtained in this way provide the engineer with a practical basis for design. With the steel described, at temperatures up to 800° C., for example, it is found that beyond a slight initial creep, characteristic of heat-resisting materials generally, a specimen may be loaded to a stress of 6.5 tons per sq. in. without suffering deformation, however long the load is maintained.

Table II shows the tensile strength of the Era/H.R. steel at various temperatures. Table III gives the "creep-stress" of the Era/H.R. steel in comparison with ordinary steel.

TABLE II.
Tensile strength of ERA/H.R. steel at various temperatures.
The tests were made at a normal rate of loading.

Temperature.	Yield point. Tons per sq. in.	Maximum stress. Tons per sq. in.	Elongation. Per cent.	Reduction of area. Per cent.
Normal	38	58.5	37.5	52
700° C.	—	31	35	57
800° C.	—	24.6	32	60
900° C.	—	19.0	30.5	64

TABLE III.
"Creep stress" for ERA/H.R. steel in comparison with ordinary steel.

Material.	Creep stress—lb. per sq. in. 500° C. (932° F.) 600° C. (1112° F.) 700° C. (1292° F.)
ERA/H.R. steel	42,500 38,000 26,000
0.30 per cent. carbon steel	13,000 4,500 less than 2,000

Resistance to Action of Gases

In the chemical industry, there are many conditions which require a metal showing marked resistance to the action of gases at high temperatures. As regards the resistance to direct oxidation by a gaseous atmosphere, the special steel scales scarcely at all at temperatures up to 1000° C. and over,

such slight scale as is formed being firmly adherent, and therefore to a certain extent protective. Even at temperatures approaching 1300° C., it still offers considerable resistance to wastage by oxidation. The comparative resistance of various types of steel to scaling at 1000° C. is shown in Table IV. In this Table are given the resistance figures of special steels referred to in this paper, also those of high chromium steel, high speed steel, and mild carbon steel.

TABLE IV.

Comparative resistance of various types of steel to scaling at 1000° C. Specimens exposed for 3 hrs., with free access of air, at 1000° C.

Material.	Loss in weight, Grams per 100 sq. cms.
Era/H.R. steel07
Era/C.R. steel17
High chromium steel	7.31
High-speed steel	7.40
Mild .16 per cent. carbon steel	28.40

Under the action of air at a temperature of 900-950° C., this alloy appears likely to last indefinitely. It also shows marked resistance to the action of sulphurous gases at high temperatures.

In contrast to temperatures above the ordinary, chemical engineering science has now to encounter problems involving the use of very low temperatures. The various processes of refrigeration, and still more the preparation of oxygen from the air on a commercial scale, may be cited as examples of the application of temperatures far below atmospheric. The subject of the effect of very low temperatures on metals and alloys has been investigated by Sir Robert Hadfield, in conjunction with the late Sir James Dewar, F.R.S., and also with the late Prof. Kammerlingh Onnes. The Société Anonyme de Commentry, Fourchambault et Decazeville, together with M. Guillaume, has also carried out most important researches on this subject in France. These various investigations have shown that at very low temperatures most metals and alloys become very brittle, but an alloy known in this country as Hecla/AMF has been produced, possessing excellent toughness under such conditions. At a temperature of -195° C., the boiling temperature of nitrogen, this material, under the well-known Frémont shock test, has a value of 50 KgM, whereas mild steel shows only 3 KgM under those conditions.

By appropriate modifications, its coefficient of expansion may be made to equal that of ordinary steel or iron, or, if desired, that of glass, a fact of obvious importance in the design of composite apparatus working over a wide range of temperature. At the temperature of -195° C., the elastic limit of this range of alloys is between 23 and 29, and the tensile strength between 41 and 48 tons per sq. in.

Non-rusting and Non-corroding Era/C.R. Steel

To meet the urgent demand for materials primarily to withstand chemical attack, where very high temperatures are not necessarily in question, a highly resistant alloy, Era/C.R., has been developed. Experiments have shown, however, that this alloy also possesses considerable high-temperature resistance. The steel is completely resistant to atmospheric corrosion, even in an industrial neighbourhood, and in tropical regions. It withstands the action of water whether fresh or saline, and, for example, is quite unattacked by sea water under alternately wet and dry conditions. Ammonium chloride or sulphate in solutions of various concentrations, cold or boiling, also the moist salts, are without action upon the alloy. Solutions of sodium sulphate or thiosulphate (hypo) do not corrode it, nor is it affected by zinc chloride solutions.

This alloy also offers a high resistance to attack by mine water containing ferrous and ferric salts in solution, and having an acid reaction; liquors of this character have been found to be very destructive of other corrosion-resisting alloys. There is complete resistance to nitric acid of all concentrations and temperatures, to acetic acid B.P. cold or boiling, citric, formic, oleic, oxalic and tartaric acids. Mixtures of nitric and sulphuric acid solutions used in various industrial processes are without action upon the alloy. Sulphuric acid solutions alone, in concentrations up to at least 25 per cent. by volume, have but slight effect. Sulphurous acid solutions, even boiling, do not affect it. A material which possesses chemical inactivity over so wide a range should prove of value in the chemical industry and other technical processes where corrosive liquids are being handled, or where articles for human consumption are being made and contamination must be rigorously avoided.

The comparative resistance to atmospheric corrosion of various types of steel is shown in Table V.

TABLE V.

Resistance to atmospheric corrosion of various types of steel. Exposed in the open air, at Attercliffe, Sheffield, for a period of 12 months.

Material	Loss in weight, Grams per 100 sq. cms.
Era/C.R. steel01
Era/H.R. steel08
High chromium steel80
Mild .16 per cent carbon steel ..	8.50

An extensive research on the welding properties of the Era/C.R. steel has recently been carried out by a firm of welding experts. They now undertake to ensure a tensile strength of 75 per cent. with regard to sheets, that is, in the actual weld. The construction of large vessels for various chemical processes is thus possible; the material can also be brazed, hard or soft soldered, or riveted without difficulty, that is, no special precautions are required. Recent experiments, carried out under working conditions, have shown that this material can be satisfactorily drawn into tubes of various sizes and lengths such as used for nitric acid plants and condensers. Tubes can also be produced by the various welding processes.

Conclusion

It is, of course, obvious that the various conditions specified above, whether of resistance to the effects of heat or of corrosion of acids, etc., are only a few of the possible cases which may arise, and it is felt that there are many problems still facing the chemical engineer, to which one or other of the several solutions suggested above may be applicable. Above all, with regard to material, there is no one means of meeting the variable conditions in chemical engineering practice. Each problem carries its own special features and demands separate consideration from the metallurgist in seeking to meet modern requirements. There is no doubt that these newer types of nickel-chromium and other steel alloys mentioned in this paper, offer great promise to the chemical engineer for nitrogen fixation, synthetic ammonia, oil cracking, nitric acid, brewery and other plant, on the one hand, and the mechanical engineer on the other. Such alloys are necessarily expensive, and not so easy to work as ordinary steels. Moreover, many difficulties have to be overcome in applying the material on a large scale for various special purposes. There is no doubt, however, that these will be overcome; in fact, this is being already accomplished.

Heat Treatment of Duralumin

At a recent meeting of the American Society for Testing Materials, Mr. R. J. Anderson read a paper on "Some Mechanical Properties of Duralumin Sheet as Affected by Heat Treatment." The effects of various annealing, quenching, and ageing heat treatments on some mechanical properties of duralumin sheet were examined in the investigation described in the paper. In the annealing heat-treatment experiments, the effects of heating at various temperatures followed by air and furnace cooling were examined. In the quenching and ageing heat-treatment experiments, the effects of quenching temperature, time period of ageing at the ordinary temperature, temperature of ageing for a constant time, time period of ageing at a constant elevated temperature, time period of soaking prior to quenching, and different quenching media were examined. The mechanical tests made on the sheet included tension, hardness, and indentation (cupping) tests. The main results of these tests were presented in graphical form, and the data were discussed briefly. The graphs show suitable heat treatments to yield particular required properties. In the tension testing of duralumin, the interesting phenomenon of slippage was encountered, and the observations made on this were briefly described. The conclusions drawn from the experiments were based on a wide variety of heat treatments and tension tests on about 1,000 specimens, with a correspondingly large number of hardness and cupping tests.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

New Commercial Uses of Tantalum

TANTALUM has, of course, for some years now been made use of in the process of hardening steels, and other possible improved applications have undoubtedly stimulated the search for natural minerals which contain this element. At one time there was a tendency for the output to exceed the demand, but there is little doubt that tantalum is destined to take an important place in metallurgical practice owing to the fact that the directions in which it can be used are so numerous. It will be recollected that tantalum was the first metal to be used in large quantities for the manufacture of filaments in the incandescent lamp industry, its value depending mainly on its high electrical resistance and melting point. It has now, however, been largely replaced by tungsten, and possibly its chief application has been in connection with instruments for surgical and dental work. Formerly it was difficult to produce tantalum of sufficient purity in large homogeneous pieces, but according to reports from Germany the well-known Siemens and Halske undertaking have recently been putting on the market tantalum ingots of dimensions larger than those previously found, and the same firm has also produced tantalum sheets and strips and vessels of considerable size. It is said that these vessels may quite readily be substituted for platinum in all cases where the latter metal is now customarily used, with the exception that the new material is not suitable for hydrofluoric acid and prolonged heating above red heat. Many other new applications are also suggested, including the use of tantalum as an electrode material, for which purpose it appears to possess decided advantages over platinum, while the metal is also recommended for the electrolysis of common salt, as well as for the construction of electrolytic rectifiers. It will be recalled that hydrochloric, nitric, weak sulphuric acid, and weak solutions of alkalis do not attack the metal; and, while hot concentrated sulphuric acid attacks it but slowly, hydrofluoric acid will attack it if both the metal and the acid are pure. A mixture of hydrofluoric and nitric acids attacks the metal with rapidity.

Amalgamation Movements on the Continent

THE German iron and steel industry, having begun its own unification in the formation of the Consolidated Steel Trust, has been anxious to arrive at some arrangement for the obviation of destructive international competition. Negotiations have been proceeding between France, Germany, Belgium and Luxembourg for the regulation of production, price, and marketing of iron and steel in these countries, and it is rumoured that agreement will be signed shortly, unconfirmed statements having in fact been made that the necessary signatures would be appended on August 12 at Düsseldorf. The method adopted by the Germans in their own internal arrangements is to apportion a definite quota of output to each unit, and it is probable that any international arrangement in which they participate will be based on a similar principle. Until more definite information is available the report that a definite agreement is almost in being should be accepted with reserve. It is quite possible that some degree of agreement in principle between the four countries mentioned has been achieved. Agreement upon definite details of a working scheme is, however, a very different matter, as such details would obviously require very close and exhaustive study. The French and Luxembourg ironmasters will probably be more easily induced to come to an arrangement than the Belgians. It is stated that the British iron industry has had no part in these negotiations, but has been kept informed of their course.

A Way for World Markets

THE exact object of these projected arrangements is not at present clear. They would, as indicated above, have the effect of obviating destructive international competition in Europe. Hints have been forthcoming of an intention of capturing the world's iron and steel markets. This would seem to imply that there is no intention of coming to an understanding with the Americans, in which case an industrial war between the continental group and the Americans would almost certainly develop. The position of a British group

separated both from the continental and American ones would be rather striking. Apart from the facts put forward above there is another point to be considered. Russia is still a somewhat mysterious factor in the world's markets, both as regards consumption and production. Her potentialities in both directions are enormous, but so far they have shown little tendency to materialise. Krupps have had an arrangement with the Soviet for some time, and it has lately been hinted that large deposits of iron ore in Russia are to be handled by a German group.

The most interesting point about the projected continental alliance is that it seems to indicate a movement towards an industrial "United States of Europe." It may be noted that suggestions of this nature have largely emanated from Germany. The I.G., for example, is stated in the German press to be angling for an alliance with the British dyestuffs manufacturers, though it should be added in fairness that in this case there are also indications of a desire to come to some arrangement with America.

The Twilight of the Gods

THOUGH it may seem ill-natured, it is perhaps justifiable, in these lean times, to derive a certain amount of consolation from the contemplation of other people's troubles. There is a certain degree of poetic justice in the fact that, according to recent reports, a great German firm is undergoing a period of stress. The firm in question is Krupps! It seems that for some time past the activities of the company have been at a rather low ebb. Possibly there may have been some improvement lately, as a result of the absence of British competition owing to the coal strike, which has, indeed, had a very beneficial effect upon the German iron industry generally; but a temporary palliative of this kind cannot be expected permanently to restore the fortunes of such a huge concern as Krupps. The remarkable organising ability of the German has of late been so evident (as, for instance, in the creation of the Interessen Gemeinschaft and other trusts), and the efficiency of Krupps has so long been proverbial that it is surprising to find that the difficulties of the company are due to faults of organisation. It appears that the late Dr. Otto Wiedfeldt, who was managing director, was especially brought in to overhaul the company and to place it on a sound basis.

It is to be expected that Krupps will experience further difficulties from the severe competition which may occur when the recently formed Consolidated Steel Trust of Germany (which was discussed in the last Monthly Metallurgical Section of THE CHEMICAL AGE) begins to function at full strength. Reports indicate that the exclusion of Krupps from the trust was due to the company's own desire. The two groups are, presumably, not on friendly terms with one another, and a price war between them should be a real battle of the giants. But who would have thought, fifteen years ago, of Krupps' difficulties? Truly, the situation is one which the Germans' own beloved Wagner would have called "The Twilight of the Gods."

The Refining of Platinum

PLATINUM, which at the prices now prevailing is the most valuable metal produced in commercial quantities, is turning up in unexpected places. Incidentally, this metal is now giving rise to a number of problems. To begin with, there is no standard of value, as is the case with gold and silver. This is to be remedied if the principal Continental countries can be brought into line, which at present is a difficult matter. The chief cause of concern amongst producers is that the price realised for concentrates sold to the refiners is out of all proportion to the value of the metals contained. This trouble is an old standing one. The refiners pay for the platinum only. In the result it has been computed that in Russia, over a long period of years, the mines have had to forgo at least 25 per cent. of the value of their output in favour of the refiners. In regard to the new discoveries of platinum in South Africa, a movement is on foot to cut out the refiners, or in other words, the producers purpose to refine their own concentrates. At present the leading refiners are almost the sole purchasers of concentrates. The moral is apparently obvious, but the matter is not as simple as it looks.

Loss in Tailings and Associated Metals

PLATINUM, by reason of its density, can, other things equal, be panned more efficiently than gold. Crude methods secure a valuable product which may contain from 60 to 80 per cent. of the valuable metal. There is, however, always a serious loss in the tailings, which, at any new workings, should be carefully kept for further treatment at some subsequent time. The recovered metals, platinum, rhodium, iridium, ruthenium, palladium and osmium, require technical treatment involving a high degree of skill and experience. Two of them, osmium and palladium, fetch considerably more than does platinum itself. In any case, the recovery of the associated metals pays, several times over, for the operation of recovering them, but as their weight is deducted, and they are not paid for, it must be conceded that the refiners have the best of the bargain. South African companies are at present contemplating other methods of disposing of their platinum. The matter is complicated by the wide range and nature of the platinum minerals which are being discovered in the Transvaal. The latest of these is sperrylite, a pure platinum arsenide. South Africa is by no means the only part of that continent wherein gold, diamonds, and platinum are found. Amateur refining will not pay, and professional refining is, as producers declare, in too few hands. A *via media* will cheapen the supplies of this interesting and virtually indispensable metal. It is in the direction of an improved and fool-proof chlorination process that South African producers anticipate that salvation is to be found.

Aluminium-Boron Alloys

BORON, being own cousin to carbon and silicon, may well be suspected of occult properties and influences on such metals as may be alloyed with it. In the main, such influences have hitherto continued occult. The desultory work done on boron alloys has been inconclusive, and the results have not hitherto been markedly successful. There are a number of compounds, proprietary and otherwise, which are said to contain boron salts and have been successfully employed as scavengers in metallurgical operations. Of actual alloys of boron with other metals, little definite is known. Although M. Paul Haenni states in the June number of the *Revue de Métallurgie* that hitherto there has been no research work on boron-aluminium alloys, he instances numerous cases of the formation of borides and carboborides of the metal. His own researches relate more particularly to the yet untitled field of the influence of boron on the physical and mechanical properties of aluminium, and he has attacked the problem from a number of angles. The most promising would appear to have been by the direct combination of boron with aluminium, in a current of hydrogen. Such combination takes place at 1,050°, after three hours, and a boronised "case" containing from 2.5 to 3 per cent. of boron, in the form of the boride AlB_2 , is then obtained. Beyond this temperature, the formation of the boride and its penetration into the aluminium proceed apace. Up to 18 per cent. of boron can thus be introduced.

Properties of Such Alloys

No dissolved boron could be found in the resulting metal. Two borides occur, however: AlB_2 and AlB_{12} . The ingots are seldom homogeneous. When, however, an aluminothermite preparation containing sulphur was fused indications were found of the formation of an eutectic (AlB_2 -Al). Even in such cases, the bulk of the borides are found uniformly distributed throughout the aluminium. With 2.5 per cent. of boron present, or more, the tensile strength and the elongation of the metal increase 100 per cent. At the same time such alloys are difficult to roll, and working appears to annul some of the extraneous properties developed. The hardness seems to be lowered. As, however, an almost phenomenally low hardness number (23) is recorded in the case of a 99.5 per cent. aluminium, rising to 43 when 4 per cent. of boron had been added, these figures may perhaps be erroneous. In the case of some aluminium-copper-boron alloys also experimented with (Al 86.2 per cent., Cu 12 per cent., B 0.8 per cent.) a hardness of 85 was found. So far as a nitric acid test was concerned the presence of boron appears to have little effect on the resistance to corrosion.

Pulverised Fuel in Metallurgy

WITH German coal at 50s. per ton delivered in Sheffield and with German slack, with close on 20 per cent. of ash, delivered, in London at 40s. per ton, it is obvious that fuel economy is intensely stimulated. Oil has been adopted with very considerable success in many metallurgical furnaces. In others, when delicate operations have to be carried out, its use has not invariably been attended with satisfactory results. In the case of pulverised fuel, the dust danger is present, although it is often exaggerated. There are so many pulverised fuel systems on the market, however, that manufacturers are chary of having to decide, at their own expense, as to the merits of the various competing systems. It is not wise to rely wholly on the *ex parte* statements of those who have a process to sell. Many of those most loudly acclaimed by their owners have given disappointing results. Either the flame does not develop adequately in all parts of the furnace chamber, leading to unequal heating, or the dust is troublesome, or some other defect reveals itself in practice. In such circumstances example is better than precept, and the experience of those who have actually tried a given process is far more valuable to intending purchasers than the reams of catalogue details which the patentees circulate on their own behalf to those interested.

The Buell Process

WHILE for power stations and boiler plants the dust problem attending the use of pulverised fuel may have been exaggerated, it certainly exists. In this connection the Buell process is said to have achieved most successful results in peculiarly trying and exigent conditions. The fact that it has been adopted by the Mond Nickel Co. for metallurgical purposes, and by works at home and abroad for the refining of tin, is itself significant. In the heating and annealing of costly ferro-alloys, such as many of the high-heat and corrosion resisting metals, and in metallurgical operations involving the melting and refining of expensive metals such as tin and nickel, the least speck of dust is not only objectionable, but may even be ruinous. Moreover, in the latter processes it is specially necessary, particularly in the case of tin at its present price, not to oxidise the bath, and so lose costly material. A pulverised fuel process, which claims all the advantages of economy, perfect control, freedom from dust, and non-oxidation, certainly merits attention.

Experimental Blast Furnace

THE experimental blast furnace maintained by the Bureau of Mines, Department of Commerce, at its North Central Experiment Station at Minneapolis, has been developed to the point where it is now possible to undertake the solution of special problems. One of these problems is the efficient utilisation of the manganiferous iron ores on the Cuyuna range and in other parts of the country. These ores are very important because of the limited supply of domestic manganese reserves. While it is the practice at a number of plants to add small amounts of manganiferous ores to blast furnace mixtures, there is some question as to the practicability of smelting a charge containing 100 per cent. of these ores. It is desirable to know whether it is commercially feasible to use these ores and if so, what grade of metal can be made from them and what type of slags will give the highest recovery of manganese. More alumina occur in these ores than in straight Lake iron ores. This fact raises a question regarding the smelting of these ores. There has been considerable speculation regarding the effect of the rather large amounts of combined water present in Cuyuna range ores. During a recent test, about 136 tons of metal were made by the Bureau of Mines in the course of 34 days' operation of the experimental blast furnace. This test was designed to cover the important phase of the problem outlined above. The results obtained will be studied to determine whether they are complete enough to permit of drawing conclusions as regards recommending a commercially feasible process for the utilisation of these ores. If this is not possible, further experiments will be made.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

At the time of writing there is, unfortunately, no ground for expecting an early termination of the coal dispute. There is no lack of suggestions from various quarters for a settlement of the trouble, and each one is held as a possible solution, but so far they have all failed to produce results. The matter has resolved itself into a test of endurance. In the last coal strike in 1921 it was, we believe, the return of the men to the pits which led to the breakdown of the strike, but on that occasion the South Yorkshire men were among the first to return. The position is somewhat different to-day. Notwithstanding the fact that the miners in South Yorkshire have the least to lose by the new proposals, and that the collieries in that district are up-to-date and yield a good wage return to the men, there is at present strong support from the men to the attitude taken up by Mr. Smith, who is not only President of the Miners' Federation but also President of the South Yorkshire Branch. They appear to be determined not to return to work until they are ordered to do so by their Association. There has been some talk of signs of wavering, but the opinion is held by some of the leaders of industry in that district that the stoppage may last another two or three months.

Imports of Foreign Coal

In the meantime large shipments of foreign coal are coming to this country, and in addition supplies are being obtained in considerable quantities from outcrops, particularly in the Chesterfield district. These sources are enabling many industries to carry on, particularly in the engineering section. In some cases departments which had been closed down are restarting. Unfortunately, the price charged for these supplies, especially for the foreign coal, is so high as to swallow any profit which the works might make on their products, unless some arrangement is made with the consumers whereby the increased cost is shared. Some works, however, find it good policy to carry on even at the increased cost if by so doing they can fulfil their obligations to their customers. The continental coal is being sold at about 55s. to 60s. delivered, and the outcrop coal at about 40s. to 45s. delivered to works.

It is apparent what an increase in manufacturing costs these prices must entail when it is remembered that the price of coal before the stoppage was not more than 20s. delivered. Moreover, the quality is proving a great obstacle to more extended use. It is a serious matter that this foreign coal is getting more and more established in the export trade, and every day that the dispute lasts adds to the difficulty of regaining these markets afterwards. One of the largest coal and steel companies in the North has already announced that five of their pits will not be reopened, and others are bound to follow suit.

Effects on Iron and Steel Trade

Naturally there is very little that can be said of the iron and steel trade itself during this period. Practically the whole of the works are still closed down. Here and there can be found a rolling mill at work, but they do not amount to much. The stocks of finished steel in the makers' works are getting very low, and soon this source of supply for the engineering and other trades will be exhausted. Pig iron has already reached that state, and although there are still a few furnaces in blast the supplies are so scarce that famine prices are being realised. In the Birmingham district as much as £5 10s. per ton has been paid for foundry iron, while some of the Scotch and Cleveland brands, with their heavier carriage, are fetching over £6 per ton delivered there. The bright drawing works are feeling the shortage of steel, and unless there is a speedy termination of the coal dispute they will have to close down. They have perforce had to take material from stock which, in the ordinary course of things, would most certainly not have been accepted, and this raises an interesting point.

Chemical Analysis

Reference has been made previously to the fact that one of the difficulties that the steel makers have had to contend with since the war has been the exacting nature of test speci-

cations and chemical analyses, amounting almost to faddishness. During the war and in the boom time of 1920 there was no great insistence on quality. Steel of any sort would sell, and apparently it fulfilled its purpose. When the demand subsided, there arose an unprecedented strictness in tests and analysis, and the cost of manufacture has been considerably increased thereby. Only too often does it happen that steel is rejected owing to some failure which is put down to the steel maker, when it is really due to the manner in which the steel is treated by the user. The tightening up of the test requirements encourages that sort of thing.

Once again necessity has broken down that extreme insistence on tests and analyses, and in many cases steel which had been rejected and thrown on to the makers' hands has been gladly accepted by the very firms who rejected it and has been used. The experience of the present stoppage has shown that the steel makers have been unfairly penalised; but they are in some measure themselves to blame. No doubt, under the force of competition they give way to these demands until there is no escaping from them. A recent instance is the lowering of the percentage of phosphorus in certain classes of steel to .04 maximum. It had long been established that an extra price had to be paid for this low limit, but a few months ago some of the makers gave way and, as stated for certain classes of steel, they now charge no extra for .04 per cent. maximum phosphorus, with the result that all the users who are aware of this movement insist on the .04 limit, whereas previously they were quite content with .05 or .06. In this, as in many other instances, the steel makers have been their own enemies.

Finished Iron Trade

The finished iron trade is about as dead as the steel trade. There is practically no production in Staffordshire, but a few mills in Lancashire are still working, using continental coal. The price obtained is 20s. to 30s. above the price ruling in April. There is no common iron being made, and the nut and bolt works are using continental iron. The fluctuations in the currency have been a strong deterrent to business in foreign material. There has been some demands for semi-finished steel from abroad, but the difficulty of obtaining delivery has been the drawback. In finished steel there is nothing doing. Inquiries are only for urgent materials to tide over present emergencies, and good prices can be obtained for any steel available. Occasionally, quotations are asked for forward contracts, but there is no desire on the makers' part to transact this class of business at present, particularly as prices are nominally unaltered. Some indication of the trend of costs, and in turn selling prices, is given by the fact that certain coke makers have been willing to book contracts for delivery after the settlement of the dispute at an advance of about 2s. on the previous price. It is quite possible that such an advance or even more may be demanded when production is once more resumed, and coal prices will have the same tendency. The steel makers are most decidedly not in a position to carry this extra burden and steel prices will have to rise. The accumulation of orders ensures this. The railway companies and other consumers are still sending specifications to the works for delivery after the stoppage, and all the mills will start with the certainty of full time for several weeks ahead. Delivery will then be the important factor and prices will to some extent take a second place. How long that condition will last is doubtful, but there is hope that it will be sufficient to give enough momentum to carry the trade on to a definitely higher and more prosperous level than it has seen for some time past.

New Dipping Pyrometer

A new dipping pyrometer for measurements of temperature of metal melts is described in *Siemens-Zeitschrift* for April. The wires of the thermo-element (for example, iron and constantin) are screwed in, the ends not being soldered or welded together, thus rendering interchange of parts easy. The welding of the ends is replaced by the dipping into the molten metal.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Recovering Metals

A PATENT application has been made by Goldschmidt Akt. Ges., of Essen, Germany, for a process for treating slags, alloys, etc., containing ferro-silicon and other metals, e.g., tin, by adding to the molten material another metal, such as lead, which will alloy with the metal to be recovered. See Patent application 251,268, having the International Convention date April 23, 1925.

Roasting Iron Ores

To obtain an iron oxide suitable for treatment in a blast furnace, iron ores containing alumina, chromium, and nickel (such as certain Cuban ores) are roasted with sodium carbonate under oxidising conditions, leached to remove sodium aluminate and chromate, and then roasted with pyrites to convert the nickel into nickel sulphate which is also leached out. See Patent application No. 251,959 (Crowell and Murray Co., Cleveland, U.S.A.), having the International Convention date May 3, 1925.

Tungsten Alloys

THE General Electric Co., London, describe a sintered hard alloy for tools made by mixing tungsten carbide containing 6-12 per cent. of carbon with 10-20 per cent. of a metal of lower melting point such as iron, cobalt, or nickel, and sintering the mass. See Patent No. 251,929, having the International Convention date March 7, 1925; Patent of addition to 213,524 (see THE CHEMICAL AGE, Vol. X, page 47, Metallurgical Section).

Extracting Metals

ACCORDING to a patent application by H. G. Cornelius, Stockholm, low-carbon iron or other metal is obtained by heating in an electric furnace briquettes of the metal oxide and a carbonaceous reducing agent, the latter being in a deficit of 5 per cent. or more; the metal is then deoxidised with ferro-silicon, etc. See Patent application 252,017, having the International Convention date May 11, 1925.

According to a Patent application by E. G. T. Gustafsson, of Stockholm, when melting a metalliferous charge in an electric furnace, the bottom of the latter is protected by introducing, prior to the charge, some slag from a previous operation. See Patent application 252,162, having the International Convention date May 16, 1925.

Aluminium Alloys

ALUMINIUM alloys which can be worked or cast contain copper, manganese, ferro-silicon, tungsten, and magnesium, with or without cadmium or sodium. See Patent application 252,028 (Barthelemy and Montby, Paris), having the International Convention date May 11, 1925.

A patent application has been made by the Metallbank und Metallurgische Ges., Akt. Ges., of Frankfurt, Germany, for the production in the electric furnace of carbide free aluminium-silicon alloys containing 34-37 per cent. of silicon. See Patent application 252,160, having the International Convention date May 12, 1925.

Roasting Carbonates

ACCORDING to a patent by A. Apold and H. Fleissner, of Vienna, alkaline earth carbonates or iron carbonate are roasted by using, as the sole heating medium, hot gases substantially free from carbon dioxide such as heated air or steam. The partial pressure of the carbon dioxide evolved being kept low, the roasting process is accelerated. See Patent No. 253,305, dated December 18, 1924.

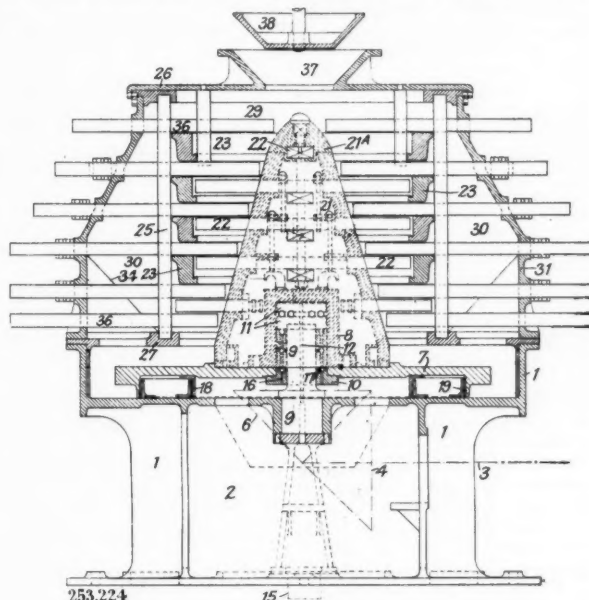
Concentrating Ores

S. TUCKER and Minerals Separation, Ltd., describe froth-flotation processes for the separation of complex ores by removing the constituents in the following order:—(a) galena, sulphides of lead with antimony, bismuth, and silver, and copper sulphide are removed in neutral or alkaline pulp with a limited amount of frothing agent; (b) zinc blende by using additional agent; (c) iron pyrites after neutralising; (d) cassiterite (tin oxide) remains in the residues. The

separation of the zinc blende is facilitated by an addition of a copper salt. See Patent No. 253,587, dated March 16, 1925.

Disintegrating Ores, etc.

F. E. WHITHAM, of Halifax, describes a machine for reducing large pieces of refractory material, or even cork, indiarubber, etc., to definite sizes by impact with beaters carried by a revolving turret. In one form of machine a conical casting 21 is driven from below and carries beaters 22 which revolve



between beaters 36 fixed in the casing 31; it revolves inside a cage formed by a number of concentric rings 23 and their supports 25. Material fed in at the hopper 37 is reduced by the beaters, in part flung through the openings in the cage, returned by the chute 34 through the lower beaters and finally flung through openings in the outer casing by the disc 7. See Patent No. 253,224, dated March 19, 1925.

Desulphurising Zinc Ores

THE zinc ores are first roasted as completely as possible and then mixed with a little carbon and again roasted in an excess of air. Sulphates are thereby decomposed and porous agglomerates suitable for reduction obtained. See Patent No. 254,389 (Mellersh-Jackson, London, from Soc. Anon. des Mines et Fonderies de Zinc et de la Vielle-Montagne, Belgium), dated April 1, 1925.

Platinum and Palladium Alloys

In a patent by G. Korsunsky, of New York, U.S.A., are described alloys of platinum or palladium with small amounts of at least two other metals which must satisfy certain conditions which are set forth. The alloys are amenable to hardening, etc., by heat treatment and are suitable for chemical apparatus, etc. For the first added metal nickel, chromium, cobalt, iron, tungsten, and molybdenum are suitable, and for the second silicon or aluminium. See Patent No. 254,666, dated April 14, 1925.

Wages for Welsh Steel Trades

AN application from the Iron and Steel Trades Confederation to increase the bonus under the sliding scale rate of wages from 10 to 20 per cent., the percentage before May 30 last, and that 20 per cent. be the minimum has been considered by the joint standing committee of the South Wales Siemens Steel Association at Swansea. The Committee has decided not to make any variation and the employers intimated that if trade became normal during the currency of the present ascertainment of the cost of steel bars the confederation might renew their claims.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Microstructure of duralumin alloys. A. Lennartz and W. Henninger. *Z. Metallkunde*, July, 1926, pp. 213-215 (in German).

Boron in aluminium and aluminium alloys. P. Haenni. *Rev. Métallurgie*, June, 1926, pp. 342-352 (in French). Preparation, examination, mechanical properties, and corrosion of aluminium-boron alloys.

Investigation of the system aluminium-zinc. O. Tiedemann. *Z. Metallkunde*, July, 1926, pp. 221-223 (in German).

Some sand-cast alloys of aluminium containing cobalt. S. Daniels. *J. Ind. Eng. Chem.*, July, 1926, pp. 686-691.

ANALYSIS.—The complete analysis of brass. Part VII. *Metal Ind. (Lond.)*, July 9, 1926, pp. 29-30, and July 16, 1926, pp. 53-54. Sampling, application, notes, and preparation of standard solutions.

A new method for the estimation of iron with titanium trichloride in the presence of copper. L. Brandt. *Stahl u. Eisen*, July 22, 1926, pp. 976-981 (in German).

The estimation of sulphur in siderurgical products. A. Kling and A. Lassieur. *Chim. et Ind.*, May, 1926, pp. 699-701 (in French).

CORROSION.—The fundamental principles of corrosion. U. R. Evans. *J.S.C.I.*, July 23, 1926, pp. 504-508.

The corrosion and rusting of steel and cast iron. Part I. R. Girard. *Rev. Métallurgie*, June, 1926, pp. 361-367 (in French). Discusses the action of weak acid solutions on ferrous metals.

Protective coatings for metals. Parts I and II. J. A. Aupperle. *Blast Furnace and Steel Plant*, June, 1926, pp. 281-283, and July, 1926, pp. 322-325. Deals with the various methods for protecting metal surfaces against corrosion.

Corrosion resistance of copper steels. *Metallurgist*, June 25, 1926, pp. 90-92.

ELECTRO-METALLURGY.—The electrolysis of the light metals. K. Arndt. *Metall u. Erz*, June (I), 1926, pp. 302-306 (in German). Describes the preparation of aluminium and magnesium.

GENERAL.—The interpretation of the macrostructure of cast metals. R. Genders. *Engineering*, July 16, 1926, pp. 88-90.

IRON AND STEEL.—Chemically resistant steels, with special reference to very high and very low temperatures. Part I. G. T. Elliot and G. B. Willey. *Metal Ind. (Lond.)*, July 30, 1926, pp. 109-110. Deals in this first article with high temperature steels.

Macroscopic examination of iron and steel. F. P. Gilligan and J. J. Curran. *Trans. Amer. Soc. Steel Treating*, July, 1926, pp. 9-25. Describes the deep-etch method of testing.

The constitution of steel and cast iron. Part II. F. T. Sisco. *Trans. Amer. Soc. Steel Treating*, July, 1926, pp. 109-118. Discusses the determination of critical points in metals and alloys.

The hardening of steel: a review and some comments. Part IV. W. T. Griffiths. *Metallurgist*, June 25, 1926, pp. 89-90. Considers the theories of the cause of the hardness of quenched steels.

General principles of the beneficiation of iron ores. Part III. T. T. Read. *Blast Furnace and Steel Plant*, July, 1926, pp. 294-297. An economic discussion of the extraction of iron from various ores.

Heat treatment data on steel castings. A. E. White. *Blast Furnace and Steel Plant*, July, 1926, pp. 314-318.

MAGNESIUM.—The founding of magnesium, its peculiarities, and recent progress therein. R. de Fleury. *La Technique Moderne*, July, 1926, pp. 426-429 (in French).

NICKEL.—Nickel and metal industries. P. D. Merica. *Metal Ind. (Lond.)*, July 16, 1926, pp. 55-56, and July 23, 1926, pp. 78-79. Discusses the technical applications of nickel.

YTTRIUM.—The preparation and some properties of metallic yttrium. A. P. Thompson, W. B. Holton and H. C. Kremers. *Metal Ind. (Lond.)*, July 2, 1926, pp. 6-8.

ZINC.—The mechanism of the reaction for the metallurgical production of zinc. P. Windelband. *Metall u. Erz*, July (I), 1926, pp. 353-356 (in German).

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

ALUMINIUM CORPORATION, LTD., London, S.W. Reg. June 19, £6,600 C debts. part of £500,000; general charge. *£1,204,148. November 18, 1925.

HEATH (ROBERT) AND LOW MOOR, LTD. (late LOW MOOR CO., LTD.), Stoke-on-Trent, coal and ironmasters. Reg. June 25, mort. or charge by way of substituted security (supplemental to Trust Deed securing £300,000 B debts.); charged on land near Ford Green, Norton-in-the-Moors, *£1,166,878. June 11, 1925.

HENDY HEMATITE IRON ORE CO., LTD., Pontypridd. Reg. June 17, £500 debts. part of £10,000; general charge. *£3,859. July 24, 1924.

SHEEPBRIDGE COAL AND IRON CO., LTD., Chesterfield. Reg. June 23, £1,750 debts. part of £750,000; general charge (excluding uncalled cap. and certain property). *£531,950. October 12, 1925.

Satisfaction

EMANUEL (A.) AND SONS, LTD., London, W., lead merchants. Satisfaction reg. June 29, £6,000, reg. July 6, 1922; £4,000, reg. June 5, 1923; and £5,000, reg. Oct. 21, 1924.

Electro-Magnetic Heat Treatment

THE application of the Wild-Barfield Magnetic Indicator to the commercial hardening of alloy steels is discussed in Heat Treatment Bulletin No. 36, issued by Automatic and Electric Furnaces, Ltd., of Elecfurn Works, 173-175, Farringdon Road, London, E.C.1. In nickel steels the nickel is permanently in solution, and the correct point to which such steels should be carried in heating is that at which they become entirely non-magnetic. In manganese steels the magnetic change point is the limit for heating. Tungsten steels containing one to two per cent. of tungsten harden perfectly if carried up to the non-magnetic point and no further. In chrome steels containing about 1.5 per cent. of chromium, sometimes used for manufacturing ball races, the chromium is rather sluggish in going into solution. The steel should be taken up to the non-magnetic point and the current switched off from the furnace, the steel being allowed to soak in the furnace for two or three minutes on an even or falling heat, when it will be in the best condition for quenching. Greater hardness and finer structure can be obtained if it is heated and quenched twice, the first quenching being in cold water and the second in warm oil. Nickel chrome steels containing about 1.5 per cent. of chromium and 1.5 to 4 per cent. of nickel require the same treatment as simple chrome steel. Chrome vanadium steel is in many cases taking the place formerly occupied by chrome nickel steel, and the treatment is the same. In vanadium steels, the vanadium, in the quantities commonly employed, never interferes with the use of the non-magnetic detector for determining the right moment for quenching. Chrome manganese steels, with about 0.6 per cent. of chromium and 1 per cent. of manganese, are perfectly amenable to treatment with the detector.

For the following the magnetic detector is useless: tungsten steels containing about 6 per cent. tungsten; stainless steel, which contains as much as 13 per cent. of chromium; molybdenum steels; high speed chrome tungsten steels, containing about 18 per cent. tungsten and 4 per cent. chromium; and chrome molybdenum steels. For cobalt steels the critical point is the point at which the cobalt becomes non-magnetic; as cobalt is very much less magnetic than iron, the detector can only be applied in special cases.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our *Monthly Metallurgical Section* should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

Modern Metallurgy and Ancient Industries

By W. Rosenhain, D.Sc., F.R.S.

We have pleasure in publishing below the substance of the Autumn Lecture to the Institute of Metals, delivered by Dr. W. Rosenhain, F.R.S., on Wednesday, on the occasion of the meeting of the Institute in Liège.

THE antiquity of metallurgy as an art and an industry is very great; on the other hand, the science of metallurgy is modern, and, in regard to some of its aspects, extremely modern.

Metallurgical science has already affected the art and industry of metallurgy in a very profound degree. We are still far removed from the stage at which we have a complete scientific basis for all the operations and processes of metallurgical industry. Such a complete basis, indeed, exists only in one or two special industries, such as electrical engineering, and the production of synthetic dyestuffs, which have been built up not by trial and error, but definitely on the basis of previously determined scientific knowledge. In this respect there is a wide distinction between the industries of modern origin which have grown up as the result of one or more scientific discoveries, and the ancient industries which have been built up by gradual development. The application of science to these latter is a matter of much greater difficulty than is the case with the newer industries.

In the story of prehistoric man, the bronze age is generally placed before the age of iron. Whether or not we accept this view, there can be no doubt as to the antiquity of copper alloys and even of copper itself. We may rightly, therefore, take the industry of copper and its alloys as typical of an ancient industry. Further, it is probable, if not certain, that some alloys of copper, such as bronze and brass, were produced and used by man long before pure copper was obtainable, although it may be necessary to exclude, from this point of view, the comparatively small quantities of copper which were found from time to time in a native state, more or less pure. The artificial production of nearly pure copper from its ores certainly represents a later stage in metallurgical history than the production of some of the alloys of copper with tin and zinc. This point is typical of the history of the development of most branches of metallurgy. Not only prehistoric metallurgists, but much later workers in that field, found it easier to produce alloys than pure metal. The advance of metallurgical science has led to the production of metals in increasing purity, and such degrees of purity as are now commercially obtained could never have been reached but for scientific development.

Inherited Skill versus Scientific Method

In the case of copper alloys, their early production by man must have been the result of the reduction of mixed ores, probably of the carbonate or oxide type, by means of fire and charcoal. No means of closely controlling the quality of the resulting product were available, and the uniformity of the results obtained must therefore have been dependent upon the uniformity of the ores worked upon. Thus arose, to a large extent, the high reputation which certain localities enjoyed in antiquity for the production of various metal articles. After a time, of course, there would also be a local concentration of knowledge and skill, often passed on from father to son.

It is interesting to notice, however, that one of the effects of modern scientific methods is to dispel the idea of inherited skill or knowledge so that, provided that those in control of the industry understand its principles thoroughly, it is by no means difficult to train new workmen to carry out the various operations in new localities. For this reason and for economic causes which outweigh considerations of localised skill in the selection of sites for industry, many of the tradi-

tional sites of metallurgical industry are finding themselves in strong competition or even superseded by new centres where the industry is growing rapidly under conditions more favourable than those which existed in the ancient centre. This is an effect of modern scientific development upon ancient industry which may perhaps be deplored in the interest not only of historical continuity, but because it so adversely affects the workers in many formerly important industrial areas.

Returning to the copper industry, we find that it begins with the production of so-called natural alloys, and it has sometimes been suggested, and is still at times maintained, that there is a particular advantage about the production of a natural alloy, and that such alloys are in many ways superior to those which can be produced by synthesis. I do not think that it is going too far to say that such a contention is entirely wrong. We know enough about the nature and constitution of metals and alloys to say that once an alloy has been properly melted and well mixed, there can be no difference in the resulting material, whatever the source from which the original metals have been derived. This statement, however, must be taken in a strictly literal and accurate manner. For example, a "natural" alloy consisting mainly of copper and tin might, in practice, prove to be very different in its behaviour and properties from an alloy consisting of pure copper and tin prepared in the same ratio as those existing in the "natural" alloy. The difference, however, would not be due to the fact that one alloy was "natural" and the other synthetic, but to the fact that the second or synthetic alloy had not strictly the same composition. Modern research has shown so clearly the great effects which small impurities or additions can produce in pure metals and alloys, that we cannot afford to neglect these as appreciable constituents of so-called "natural" alloys. If, therefore, a "natural" alloy is found to be of complex composition, it may not always be sufficient, in reproducing it synthetically, to melt together the two or three main constituents. Careful examination is required in order to ascertain which of the minor constituents may be of importance. On the other hand, it must also be realised that many of these so-called minor constituents or impurities in natural alloys are deleterious, and that their elimination in the synthetic product leads to improved properties. At all events, there can be little doubt at the present time that the era of "natural" alloys is rapidly coming to a close.

"Natural" and "Synthetic" Alloys

The suggestion is sometimes made that in a natural alloy the metals are more intimately combined than when the material is prepared synthetically. There is no justification for such a claim. Unless entirely unsuitable mixtures are used, there is nothing easier than to produce complete mutual solution of molten metals in one another. Particularly in the case of copper, alloys with zinc, tin, nickel, etc., are most readily prepared and extreme uniformity of composition can be obtained in a short time by suitable stirring, etc. It is true that some manufacturers think it desirable to remelt their alloys several times before making castings. It may be that some advantage can be gained by such an operation, but this is probably to be ascribed to the elimination of gases and not to the more intimate mixing of the alloyed metals.

The progress implied in the production and use of approxi-

mately pure metals in place of "natural" alloys has been continued in recent years, under the influence of scientific and metallurgical developments, in the direction of the production and employment of metals of exceedingly high purity. This has, perhaps, been nowhere pushed further than in the case of copper. The older methods of copper refining by means of furnace treatment, leading to the production of those varieties of copper which are known in England as "best selected" and "tough pitch," result in a grade of copper which, in favourable circumstances, is capable of giving excellent mechanical results, combining great toughness and ductility. The advent of the electrical industry, with its enormous demand for copper and its exacting conditions as to electrical conductivity, however, has led to a further development. It was soon discovered that the electrical conductivity of copper is very adversely affected by the presence of minute amounts of particular impurities, such as arsenic and iron, which are never entirely absent in copper which has been produced by furnace refining. Fortunately, the electrical industry, at the same time as producing the demand for high conductivity copper of extreme purity, has also provided the means for its preparation by electrolysis.

Refined Copper

The electrolytic refining of copper has rapidly grown until at the present time a large proportion of the world's output of copper is treated in this manner. The direct product of electrolytic refining, known as cathode copper, is a material of exceedingly high purity. Apart from the enclosure of small quantities of the fluid electrolyte, in which the copper is refined, impurities are practically absent. Unfortunately the copper cannot be used either for electrical or most other purposes in the form of cathode in which it is obtained from the electrolytic refining bath. It has to be remelted and cast into ingot form. In doing this, unfortunately, the copper absorbs impurities, mainly derived from the furnace gases, principally oxygen and sulphur. Further furnace refining operations have therefore to be used in order to eliminate, in the first place, the sulphur, by oxidation. This process, known in American practice as "flapping," leads to the production of a bath of molten copper containing a large proportion of oxygen. Now, oxygen itself is an impurity which produces undesirable results when too much of it is present in copper. It has recently been shown, in fact, by research carried out by some of my own colleagues at the National Physical Laboratory on behalf of the British Non-Ferrous Metals Research Association, that in copper, otherwise entirely free from impurities, the presence of any oxygen is undesirable; and, for many purposes, the lower the oxygen content can be brought the better the resulting copper. In technical practice, however, one has rarely to deal with copper as pure as this, and, further, the very method by which the oxygen content is reduced is liable to introduce impurities. These may consist of gases such as hydrogen, or, possibly, of a certain amount of sulphur, which are derived from the wood or other material introduced into the molten copper in order to reduce the oxygen content in the process known as "poling." Consequently it is not possible to carry deoxidation to the limit, but a certain amount of oxygen must be left in the copper, where it remains in the form of oxide, in order to secure the maximum degree of toughness and soundness of the material.

When all these processes are carried out as carefully and accurately as possible, the resulting copper is a material of very high purity. It may contain as little as 0.01 per cent. of oxygen, and the total remaining impurities may not be more than 0.06 per cent. In this form it is particularly useful owing to its high electrical conductivity. While the electrical uses of copper are perhaps more exacting in their demands upon purity than any other applications of that metal, there can be no doubt that there is at the present time a strong tendency, based upon the results of scientific experiments, and confirmed by practical experience, to insist upon very high purity even when the copper is used in the production of alloys valued for their mechanical properties.

Two Forms of Impurities

In this connection it is perhaps worth while to consider the various ways in which impurities appear in a metal and influence its properties. Broadly speaking, impurities may take two distinct forms. Some of them, owing to the difficulty

with which they can be taken up by the crystals of the parent metal, form separate constituents which can be readily identified under the microscope, even when only quite small amounts are present. Bismuth is perhaps the most striking example of this kind of impurity in the case of copper. Owing to the fact that bismuth takes the form of minute films or cell walls lying in the boundaries between adjacent copper crystals, its presence rapidly destroys the mechanical cohesion of the metal and renders it weak and brittle. On the other hand, since it does not enter to any appreciable extent into the structure of the crystals of copper themselves, it does not disturb their internal arrangement very much and so does not interfere seriously with their power of conducting electricity. Oxygen is an impurity which behaves in a similar manner, being present in copper in the form of cuprous oxide (Cu_2O), which forms with copper what is known as a typical eutectic alloy.

Impurities in Solid Solution

Arsenic is typical of the second class of impurity. Here the atoms of the impurity are more readily adaptable to incorporation in the crystal structure of the copper itself, and, as a result, when the amount of arsenic present is small, it cannot be detected as a separate constituent under the microscope, but exists in the most intimate mixture, or, as it is called, solid solution, in the crystals of copper. The consequence is, in this particular case of arsenic and copper, that the mechanical properties of copper are not adversely affected until the amount of arsenic becomes considerable. On the other hand, the effect on the electrical conductivity is very great because the presence of the arsenic atoms in the crystals themselves destroys the complete regularity of their structure and interferes with the passage of the electrons which carry the electric current. It should, perhaps, be added that, while we have here considered the impurities in connection with their behaviour when present in copper, similar conditions exist with regard to various impurities in other metals, some forming separate constituents, while others are retained in solid solution.

It is not possible, within the scope of the present lecture, to go into fuller detail in regard to the influence of impurities in copper and its more important alloys. Enough has been said, however, to indicate that modern requirements demand a degree of purity in copper which could not be obtained by the older metallurgical methods, and that consequently, modern developments have resulted in a change of practice which to a large extent is revolutionising the industry by bringing about the increasing use of electrolytic refining. This demand for metal of very high purity makes itself felt not only in the material which is to be used in that pure condition, as for electrical purposes, but also in the production of alloys, in regard to copper and to other metals. Amongst these, zinc is perhaps the most important in the metallurgical industries and interests of Liège and its neighbourhood.

Zinc

For a long time the production of zinc has been carried on in Belgium and elsewhere by the well-known distillation process. It is also well known, however, that the zinc produced in this way, although the best qualities attain a high degree of purity, cannot be freed from appreciable amounts of lead and iron. For a great many purposes zinc of the purity obtainable from the distillation process has proved perfectly satisfactory and will, no doubt, long continue to do so. The process has the advantage, as compared with others, in which still higher purity is attainable, of yielding a much cheaper product, and this cheapness, particularly in the case of zinc, is very important. None the less, here also the modern tendency towards the production of much purer metal is making itself felt. Again, the furnace or distillation methods are being surpassed in regard to the purity of product by an electrolytic process. By this means the content of lead and iron in the resulting zinc can be very much lowered, and for some purposes this is a great advantage. In certain varieties of brass, for example, which are used for special purposes, the elimination of lead is necessary.

Freedom from lead in the zinc employed may also be of considerable importance in the case of certain aluminium alloys. An interesting example of the way in which lead affects the behaviour of aluminium-zinc alloys recently came under my notice. The alloy of zinc and aluminium containing

about 78 per cent. of zinc has the remarkable property of undergoing spontaneous heating and temporary hardening after it has been quenched from a temperature of 380°C . When the alloy is made from high-grade aluminium and pure zinc free from lead, this reaction is rapid and strongly marked. Recently an attempt was made to reproduce this phenomenon in an aluminium-zinc alloy made with a cheaper grade of zinc in which lead was present, and although the reaction still occurred to a feeble extent, the whole character and magnitude of the phenomenon was altered. So much so was this the case that it is probably right to say that if zinc free from lead had not been used in the original investigations on these alloys, the whole phenomenon would not have been discovered. This, in itself, merely goes to emphasise the well-known principle that in the scientific investigation of alloys it is necessary to secure materials of the highest possible degree of purity.

Properties of Very Pure Zinc

While modern commercial electrolytic zinc is a product of high purity, it is by no means a pure metal in the scientific sense of the word. Quite recently the New Jersey Zinc Co., of Pennsylvania, America, has devoted attention to the production of very pure zinc. They have prepared two varieties, the first, which they describe as "chemically pure" zinc, in fairly considerable quantities, and the second, which they describe as "spectroscopically pure" zinc, only in minute amounts in the laboratory. The chemically pure grade is stated to contain 99.987 per cent. of zinc, but when examined spectroscopically is found to show traces of lead, cadmium, and iron. The spectroscopically pure metal is prepared in very small amounts in the laboratory by repeated distillation at low temperature and under a high vacuum, starting with the chemically pure metal and rejecting the first and last portions of each distillate. This fractional distillation is repeated until the arc spectrum shows the absence of impurity lines. It is believed that this metal cannot contain much more than 0.0001 per cent. of impurities. It is stated that these materials differ widely from the best commercial zinc in various properties. The most notable feature is their resistance to solution in acid. As is well known, a piece of ordinary pure zinc when wrapped in a platinum wire and suspended in dilute hydrochloric acid dissolves away rapidly, with violent evolution of hydrogen. The chemically pure variety of zinc, treated in this way, takes a period of a week to undergo solution while the spectroscopically pure variety is said to dissolve at a rate approximately one thousand times slower. It is very probable that a metal which shows so great a resistance to solution in hydrochloric acid will also exhibit chemical inertness towards other agents, and the corrosion resisting power of a zinc coating may thus be immensely improved by a marked increase in purity.

Another interesting property of these special qualities of zinc is the low recrystallisation temperature. This makes it possible to roll this metal without exceeding a temperature of 40°C . and yet to avoid cold-working it. Without going further into the remarkable properties of these samples of zinc, it is clear that they reveal properties in the metal which have never been suspected from the commercial variety. The effect of the first small quantities of impurity is thus a very large one in the case of zinc and may prove to be so in other metals.

Tin and Aluminium

The tendency towards greater purity which we have noted in the case of copper and zinc makes itself felt also in the case of two other metals, tin and aluminium. While the former of these may well be regarded as the product of an ancient industry, the latter is essentially the result of comparatively modern scientific research. None the less, the same tendency is already making itself felt there. In both cases, an effort towards the production of purer grades of the metal has come from within the industry, and not from independent researches. In the case of tin, a variety of the metal has recently been produced industrially which represents a considerable advance in regard to purity upon the best varieties of tin formerly commercially obtainable. A careful analysis carried out by special means has recently been published and shows that this metal contains total impurities amounting only to 0.0082 per cent. The greater part of these are due to lead, 0.0025 per cent., and antimony, 0.0031 per cent. In comparison

with this it may be said that in ordinary standard varieties of tin the impurities vary from 0.094 per cent. to as much as 0.34 per cent. Actually it is not only the total amount of impurities but their variability in amount and in the proportion of the different constituents which is disadvantageous to the user of the metal.

While tin is perhaps among the commercial metals one of those most easily reduced from its ore, aluminium lies at nearly the opposite extreme. For a long time after its discovery it was regarded as a laboratory curiosity and its price was an impractically high figure. Modern improvement in the methods of production by fusion electrolysis from a molten bath of cryolite in which alumina is dissolved, resulted in its production at a remarkably cheap rate. The price is still, however, high when compared with that of iron and steel, and in spite of all that has been done to develop alloys of aluminium of very high strength, the price will still have to be reduced to something like one-half or one-third of its present value before the best of the aluminium alloys can compete, strength for strength, on equal terms with steel in regard to cost. In spite of this circumstance, however, there is a great development in the industrial uses of aluminium and its alloys in connection with aircraft construction and in high-power internal combustion engines. From the point of view of the present lecture, although aluminium cannot be regarded as the product of an ancient industry, it is particularly interesting because, until recently, it was not possible to purify or refine it once it had been reduced electrolytically from its ore. Within the last few years, however, Edwards and his collaborators, in America, have perfected an electrolytic refining process in which molten aluminium forms both the anode and the cathode of the cell, passing by electrolysis through the fused electrolyte from the impure anodic metal to the highly purified cathode. The result is the production of an aluminium of much higher purity than anything that has hitherto been obtained. The best sample of aluminium which I have been able to obtain prior to the improvement just mentioned contained about 99.7 per cent. of aluminium, the remainder being mainly iron and silicon. Samples of aluminium refined by the new American process, on the other hand, contain over 99.95 per cent. of aluminium. This high purity metal again presents marked differences in properties and behaviour from the less pure variety.

Control of Composition and Treatment

In what I have said above I have emphasised the influence of modern scientific developments on the ancient industries concerned with the production of metals from their ores in securing a much higher standard of purity in those metals, and I have indicated the directions in which the methods of the old industries are undergoing changes and improvements in order to meet these modern requirements. The whole situation may be summed up by saying that as our scientific knowledge of metals and alloys increases we find it necessary to pay more attention to an exact control of their composition and treatment. A fuller realisation of the influence exerted, sometimes by minute amounts of impurities, leads us to realise the necessity for knowing exactly not only the general or average composition of our materials, but in many cases their composition in the minutest detail. As a result it is found desirable to use, wherever possible, raw materials of the highest purity.

Still more, our knowledge of the effect of mechanical and thermal treatment of metals and alloys is rapidly increasing. Forty or fifty years ago, the application of heat treatment even in the case of steel was still exceptional. To-day, it is still to some extent exceptional in the non-ferrous alloys. In the near future it is likely to become an important factor in the industrial manipulation of alloys. Those, therefore, who produce metals from their ores are likely to find in the future an increasing stringency in the requirements of those who purchase metals from them. But there need be no fear of the stringency of those demands creating insuperable difficulties, either technical or commercial. The advance of metallurgical science and, parallel with it, of other branches of science and technology, is likely to provide not merely higher or more correct standards of quality in regard to materials, but also better means for their production and treatment; so that, on the whole, the ancient industries are likely to benefit rather than to lose by future progress.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Autumn Conferences

THE autumn meetings of both the Iron and Steel Institute and the Institute of Metals have this year been held out of England—the former at Stockholm, August 27 and 28, and the latter at Liège, September 1 to 4. The practice of combining a pleasant holiday with the reading and discussion of papers has many advantages, not the least important of which is the general educational effect of visiting other countries and establishing personal contact with their works, works managers, and well-known metallurgical experts. We have received no account yet of the Stockholm Conference, but the range of the discussions is sufficiently indicated in the list of papers, namely:—F. Adcock, "The Effect of Nitrogen on Chromium and some Iron Chromium Alloys"; J. H. Andrew and H. A. Dickie, "A Physical Investigation into the Cause of Temper Brittleness"; Professor C. Benedicks, H. Bäckström, and P. Sederholm, "Anomalies in Heat Conduction, with some Determinations of Thermal Conductivity in Iron and Carbon Steels"; Professor C. Benedicks and R. Sundberg, "Electrochemical Potentials of Carbon and Chromium Steels"; G. F. Comstock, "The Treatment of Steel with Ferro Carbon-Titanium"; G. A. Hankins, D. Hanson, and Miss G. W. Ford, "The Mechanical Properties of Four Heat-Treated Spring Steels"; Professor K. Honda: "Is the Direct Change from Austenite to Troostite Possible?"; A. Johansson and R. Von Seth, "The Carburisation and Decarburisation of Iron and Some Investigations on the Surface Decarburisation of Steel"; A. Johansson and A. Wahlberg, "The Development of the Swedish Iron and Steel Industry during the Last Thirty Years"; E. Kinander, "Notes on Jernkontoret"; A. Lundgren, "The Testing of Hardened Steel"; W. Petersson, "Notes on the Development of the Swedish Mining Industry during the Last Twenty-five Years"; G. Phragmen, "The Constitution of the Iron-Silicon Alloys."

Purity of Metals

THE subject of the purity of metals, especially those most commonly used in chemical operations, is attracting attention from many angles. It was dealt with by Dr. Rosenhain in his autumn lecture before the Institute of Metals at Liège on "Modern Metallurgy and Ancient Industries," which is reprinted in this issue. Dr. Rosenhain points out that impurities in metals usually assume two distinct forms; they may form separate constituents, when they are apt, as in the case of bismuth in copper, to destroy the mechanical cohesion of the metal and render it weak and brittle. Or they may adapt themselves to incorporation in the crystal structure of the parent metal, that is to say, pass into solid solution. The whole question of impurities in metals resolves itself mainly, therefore, into the degree of heterogeneity they introduce. Pure metals are, within their degrees of purity, which is sometimes relative only, homogeneous, and as such their physical properties are those of the pure crystal, without the perturbations introduced by heterogeneity, the presence of foreign impurities. Sometimes the intimate intrusion of an impurity in the crystal structure of metals improves certain desirable physical characters. The presence of, so to speak, unassimilated impurities, or true heterogeneity, can seldom do this, other than by some kind of physical bonding, or when a harder material is embedded in a softer matrix and serves some useful function. The useful function of a "ghost" is difficult to conceive; it is always a source of dangerous potential weakness. Where a material is required permanently to withstand stresses up to those ultimately disruptive of the given metal, the behaviour of a pure, that is to say of a homogeneous metal, can be predicted with greater accuracy than when it is heterogeneous and contains diffused or segregated impurities not in solid solution.

Light Alloys in Engineering

THE increasing amount of attention now being directed to the light alloys is evinced by the large number of papers before the Institute of Metals devoted to a consideration of the relations of aluminium and silicon to one another. No fewer than three papers were presented on this subject, while three

others dealt with aluminium or magnesium in other connections. Thus six out of the sixteen papers dealt with light metals and their alloys. There can be little doubt that the future will be an age of alloys and that so far as engineering is concerned it will involve the judicious employment of anti-corrosive and heat-resisting heavy alloys in conjunction with masses of light alloys used for purely structural and engineering purposes for which iron and steel have hitherto been employed. Moreover, the resistance of the light metals and alloys to corrosion is being exhaustively studied and has been by no means fully explored, and the same may indeed be said in regard to their physical strength.

Silico-Aluminium and Its Metallurgy

THE paper by B. Otani on "Silumin and its Structure" was the first on the list at Liège. Silumin is an aluminium-silicon alloy the properties of which are profoundly modified by the use of metallic sodium or of alkaline fluorides during its preparation. In Mr. Otani's paper only the equilibrium diagram was seriously discussed. The paper by Mr. J. D. Grogan on "Some Mechanical Properties of Silicon-Aluminium Alloys" was of a more practical nature, dealing with the actual methods employed, and not merely with the theoretical considerations. The hardness and strength of these alloys increase with the percentage of silicon present, within the limits of the experiments described (8 to 14 per cent. of silicon), while the elongation, density, and impact value decrease. The paper by Messrs. Gwyer and Phillips on "The Constitution and Structure of the Commercial Aluminium Silicon Alloys" has an appendix by Messrs. Stockdale and Wilkinson, on their properties. The alloys possess good founding properties, and while appreciably lighter than pure aluminium possess high shock resistance, corrosion resistance and ductility, either when cast in chills or in sand. The best all-round combination of properties is that obtained in an alloy with 11 per cent. of silicon. The troublesome reverse action encountered on heating other alloys, particularly of the nickel types, does not occur to complicate the issue in these alloys, which give the best results when the iron content is kept low. A certain degree of "ageing" appears to take place. The very respectable tensile strength of 15.04 tons per square inch, with an elongation of 17.2 per cent. on 2 inches, and a Brinell hardness of 65, can be obtained in a "typical" alloy of this class.

Nickel for Coinage

THE question of the use of nickel in coinage, always a matter of considerable interest, has of late been especially to the fore. The subject was dealt with at the Liège meeting by Captain F. R. Barton in a paper on "The Development of the Use of Nickel in Coinage," discussing the historical development of the application of nickel to coinage and the difficulties encountered and overcome in adapting it to this purpose. Captain Barton pointed out that in its pure form, as well as a constituent of binary alloys, nickel has been widely adopted during the last half-century as a coinage metal. Experience shows that pure nickel coins wear longer in circulation than those made of silver, and that they are equally proof against counterfeiture.

A discussion of matters related to those mentioned above has recently appeared in *The Times Trade Supplement* in an article (obviously by a well-informed authority) on "Silver in Token Coinage." It is there pointed out that among the economic changes that have been taking place in Europe since the termination of the war, there is one of considerable importance, appertaining to monetary science, which has not received as much public attention as it deserves—namely, the statutory reduction of the intrinsic values of token coinages formerly made of silver, a reduction which has been effected by diminishing the proportion of silver in the coins, or by the adoption of base metals in total displacement of silver. In the case of British silver money, for instance, the purity of the metal has been lowered by 42.5 per cent.; France has adopted aluminium-bronze in place of silver for 2f., 1f., and ½f. pieces, and Italy and Belgium have adopted pure nickel for those denominations. The inducement to substitute base metals for silver, in whole or in part, arose from the high

market price of the metal in 1919 and 1920, and was fortified by the belief then held that the price would eventually become stable at a figure some 100 per cent. higher than its pre-war level. After pointing out that our present silver currency is a wasteful extravagance, the writer mentions that the Irish Free State has recently passed a law which authorises the replacement of the sixpenny and threepenny pieces in circulation there by nickel coins of much more convenient size than the current coins. "This is a precedent which appears well worth following on grounds of both economy and improvement. By adopting it we should also learn whether the public and the banking interests were likely to accept nickel complacently for higher denominations of our token money, it being essential in carrying out any monetary reform to recognise the desires and tastes of the community."

Cadmium-Zinc Alloys

CADMIUM alloys have been attracting attention for some time past, and special interest therefore attaches to a paper by Mr. C. H. M. Jenkins on "The Constitution and the Physical Properties of the Alloys of Cadmium and Zinc" read at the Liège meeting of the Institute.

This paper contains the results of a study of the metallography and the physical properties of some of the alloys of cadmium and zinc. The constitution and properties of the zinc-rich alloys seems to be considerably influenced by the two polymorphic changes which appear to occur in zinc. One of these changes caused an increase in the solid solubility of cadmium in zinc above the eutectic temperature; the resulting equilibrium diagram is therefore somewhat unusual, containing a region representing a completely solid alloy occurring above an area which is composed of both liquid and solid alloys. It has been found that the cold-worked alloys very slowly soften at room temperature, but the effect of ageing does not cause any unfavourable alteration. The zinc-rich alloys should not, however, be annealed subsequently to this ageing. The properties of cast and rolled zinc appear to be improved by the addition of cadmium. The eutectic alloy, previously proposed for use as a medium hard solder, possesses very suitable physical properties for this purpose.

The Microstructure of Mercury

A VERY interesting piece of research on the microstructure of mercury is described by Dr. W. Rosenhain and Mr. A. J. Murphy in the course of a recent letter to *Nature*. They state that in the course of investigations on dental alloys and amalgams, which they have carried out at the National Physical Laboratory on behalf of the Dental Investigation Committee, Department of Scientific and Industrial Research, they have thought it necessary, for the full study of the constitution of the amalgams, to undertake their microscopic examination. As mercury, and the amalgams rich in mercury, must be completely solidified for this purpose, it has been necessary to devise means for the preparation, etching, and photo-micrography of specimens at very low temperatures. Most of the work has been done by means of a paste of carbon dioxide snow and acetone. Surfaces suitable for microscopic study have been prepared by allowing the metal to solidify in contact with glass, and such surfaces have been successfully etched by electrolysis in hydrochloric acid (sp. gr. 1.12 at 15° C.). It has also proved possible to polish the frozen specimens, but so far it has not been found possible to etch surfaces prepared in this way. Special devices have been used for keeping the lenses of the microscope, etc., free from deposits of frost during examination and photography.

European Steel Trust Negotiations

THE question of the formation of a continental steel trust, comprising Germany, France, Belgium and Luxembourg, which was discussed in the last Monthly Metallurgical Section of THE CHEMICAL AGE, is still unsettled. It seems that Germany and Luxembourg have definitely signed the "pact," while France and Belgium are considering the position, and their decisions will be made known during the course of this month. The main difficulty is the attitude of the Belgians, who think the quota of production allotted to them insufficient. It is felt on the Continent that these difficulties will be smoothed over and that the trust will ultimately come into being. According to the draft signed by Germany and Luxembourg (which is intended to be the basis for the general

agreement) the sum of one dollar for every ton of raw steel produced by Belgian, Luxembourg, the Saar, Lorraine, and Ruhr districts will be paid into a common treasury. Representatives of these districts will from time to time estimate their productive capacity, and will agree on a production quota slightly below this capacity. Districts producing more than the quota agreed upon will pay four dollars on every ton of raw steel produced in excess of the quota into the treasury. The districts not attaining the quota will receive compensation of two dollars for every ton short of their quota. The total production fixed for Germany, France, Belgium and Luxembourg is 2,300,000 tons.

Protection of Aluminium by Anodic Oxidation

AT the recent meeting of the British Association in Oxford, Dr. G. D. Bengough and Mr. H. Sutton read a paper on the protection of aluminium and its alloys against corrosion by anodic oxidation. It has been thought that the resistance of aluminium against corrosion might be greatly increased if a thick and strongly adherent film of oxide or hydroxide were formed on the metal, instead of the natural thin film. The authors used a bath containing chromate, bichromate, or chromic acid. In carrying out the treatment, two practical points had to be noted. The immersed material must consist only of aluminium or suitable aluminium alloys, since other commercial metals were usually attacked by the process and prevented the raising of the voltage; also, the bath should be large compared to the material as otherwise the heat produced by the current would make it difficult to regulate the temperature of the bath. In cases where a sufficiently large bath was impracticable cooling coils might be used to remove the excess of heat. The coating seemed to consist almost entirely of aluminium oxide in a glassy, adherent form. The oxide was possibly hydrated to some extent, but the amount of hydration could not be large as the coating might be heated to at least 350° C. without changing in appearance or tenacity. The amount of the chromate in the film was determined by stripping the film from a measured area of commercial aluminium with caustic potash, and the average result of three determinations gave 0.041 grammes of CrO_3 per square metre.

The Results of the Treatment

EXPERIENCE had shown that the article under treatment, if completely immersed, must consist entirely of aluminium, duralumin or a suitable aluminium alloy. It had been found more convenient to treat the pieces by double immersion, each immersion covering rather more than half of the surface of the piece, so that no part remained untreated. The effect of the double treatment was to leave a very noticeable band across the piece, corresponding to the surface of the solution during the second immersion. Standard treatment of commercial samples and articles of aluminium and duralumin presented no difficulties. Good samples of aluminium sheet required a current density of 3 to 3.6 amperes per square foot as a maximum, but the maximum current density was found to vary to a considerable extent according to the articles being treated. It was high in samples of aluminium which had a rough surface or were unsound. Pieces of aluminium which had been worked up into special shapes by spinning or hammering, without subsequent polishing, showed higher current consumption during anodic treatment, maximum values as high as 6 amperes per square foot having been noted. The nature of the surface of the metal under treatment had a marked effect on the current consumption.

The anodic process provided a protective coating at pores and cracks, but water line conditions of corrosion broke down even the anodic film. This difficulty, however, had been overcome by dipping the article in molten lanoline or in a solution of lanoline in a suitable solvent—e.g., a 15 per cent. solution in benzene, or into a lanoline emulsion. The lanoline was absorbed by the film and held very tightly and prevented the gradual penetration of the film as a result of wetting and drying. The net cost of treatment in the experimental bath worked out at 1.93d. per square foot, but the principal cost was labour, and under commercial conditions it was anticipated that the figure would be much lower, something like 1d. per square foot for either aluminium or duralumin. The investigations showed that the treatment, combined with lanoline treatment, increased substantially the corrosion resistance of the two metals named.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

At the end of this the fourth month the coal strike is still in being, and there are no definite signs of its termination. It has already lasted one month longer than the previous strike of 1921. It is to be feared that a settlement reached by exhaustion of one of the parties is not calculated to promote good feeling between masters and men, and the knowledge that sheer necessity has compelled them to yield may engender a spirit of resentment among the men which will be the forerunner of further trouble later on. On the other hand, an agreement reached by bargaining between the owners and the men's officials, even if it resulted in a reduction of wages or an increase in hours, would still mean that the settlement had been a matter of agreement and not entirely of compulsion, and that would be a much better groundwork on which to build up the future prosperity of the industry. Co-operation both in spirit and in action is what is wanted, not an antagonism which is for ever seeking some means of venting itself.

Although the end of the dispute is not yet in sight, events are happening which are likely to hasten that day. The number of men who are returning to work is slowly but surely increasing. Each day that passes makes more certain the possibility of district settlements, which, after all, is the most reasonable way out of the difficulty. Already there have been several individual agreements made for the resumption of work. Some have embodied a working day longer by half an hour, at the same rate of pay as that which obtained before the stoppage; others have included a reduction in wages whilst retaining the seven hour day. There may be some cases in which both alterations may be necessary. It is the natural thing for each district to decide which alteration shall be made, according to the particular conditions prevailing in that district. There are collieries, notably some of the South Yorkshire pits, where seven hours is all that the men ought to do, but there are others where eight hours is quite a reasonable working day. The existence of such diversity in actual working conditions is the great argument for district settlements, and it is very likely that there will be a resumption of work on these lines.

The colliery owners have not been without blame in this matter. They have missed opportunities for making a settlement which would, in a large measure, have achieved their aims, while at the same time giving the men's leaders a chance of withdrawing honourably from their position. The last conference between the two parties was an example of mistaken tactics on the part of the owners. To say nothing of the unfortunate manner in which the proceedings opened, the men's leaders were met with a stubborn insistence on the eight hours' day, which on the face of it was ridiculous, in view of the fact that in at least one district the owners had already agreed to 7½ hours and the men were going back on that understanding.

Premium on Steel Prices

The supply of coal is increasing. Deliveries from abroad are still coming in, the outcrops are still giving good yields, and the collieries that have resumed work are adding their quota to the market. Many industries allied to the iron and steel trade have been able to carry on all through the strike, and they are finding the position just a little easier. Dorman, Long and Co. have just announced that they are starting three furnaces and one plate mill, and this will be welcome news to many consumers. There is, of course, no difficulty in finding an outlet for any supplies of steel that can be turned out, and a premium on the price can be obtained, although the extra cost of manufacture will largely swallow up this premium. Owing to the general expectation of an early resumption of work in the collieries there has been more inquiry for steel, and consumers seem disposed to make contracts for supplies after the strike. Most of the works are willing to take such business. Sometimes attempts are made to secure a little higher price to cover the uncertainty of the future, but in general makers are not asking more than the 5s. advance which was unofficially fixed in the early part of the strike. Most people are agreed that there will be an increase in the price of fuel when work is again resumed, if only on account of the abnormal demand for coal that will arise immediately

the steel works are in operation; but whether such an increase will be of short duration only or be more permanent is a matter for argument. Assuming that the longer working day is established without any increase in wages, it is hoped that ultimately there will be a reduction in the price of fuel, which would be very helpful indeed to the steel makers.

Revival Prospects

Many of the leaders in the industry have expressed their belief in a revival in the trade after the present dispute is settled. There is a world shortage of steel, and, as far as this country is concerned, the shortage has been aggravated by the closing down of the steel works. Financial conditions have prevented this shortage being turned to good account, but the greater stability that has been reached on the Continent will have its due effect in restoring the market to normal conditions. Evidently this optimistic outlook is held on the share market, as there have been notable advances in the prices of almost all the leading coal, iron, and steel shares during the past week or two. No doubt one cause of this is the knowledge that all the works have a sufficient accumulation of orders to keep them going for at least two months. It must not be overlooked, however, that the long period of idleness has entailed very serious losses which will take several months' good work to liquidate.

Steel prices remained unchanged. Plates are still at £8 2s. 6d. basis, sections at £7 7s. 6d. Pig iron prices are very firm, as there is practically no iron available, and the good demand for deliveries when the furnaces restart will make it unnecessary to reduce prices for the home trade. Possibly some reductions will have to be made for export orders, as that market will need nursing again.

The production figures for July are merely a reflection of the stoppage. There were only eight furnaces in blast at the end of the month, as compared with 147 at the end of April. The output of iron was 17,900 tons in July. Steel ingots and castings amounted to 32,100 tons, as compared with 561,000 tons in April.

Copper and Steel Rusting

As the result of an investigation carried out by a United States railway company, it is thought that the effect of the presence of copper in minimising the rusting of steel has been definitely established. The beneficial effect of copper seems to increase when it is present in amounts up to 0.3 per cent. of the whole, as has been demonstrated by the exposure of plates with increasing amounts of copper for months and years. The manner in which this beneficial effect is achieved is a matter of doubt. It is suggested that the copper acts beneficially by fixing the sulphur, which under ordinary circumstances is in the form of iron sulphide, as more stable copper sulphide. Alternatively it is thought that the action of the copper is to produce a more coherent and denser form of rust, which acts protectively. A still further explanation, due to Evans, is that with the first stage of oxidation the copper is unattacked and is left as a thin film on the surface of the iron, and that this provides the real protection. In this case the iron becomes self-plating.

Chloridising, Roasting and Brine Leaching of Ores

In its general study of chloridising, roasting and brine leaching of ores, the Bureau of Mines, Department of Commerce, at its Intermountain Experiment Station, Salt Lake City, Utah, will, during the coming year, concentrate on the obtaining of cheap hydrochloric acid and calcium chloride, which are needed for controlling the brine circuit. The purpose of this study is to work out a process for the treatment of silver precipitate which is contaminated with copper and arsenic, and to encourage, in every way, the saving of lead which is being run to waste. Work on the precipitator which successfully utilised sponge iron as a precipitant during the past year will be continued, and the use of sponge iron as a precipitant encouraged.

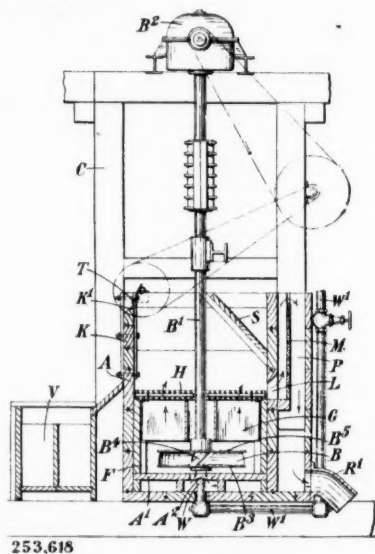
Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Froth-flotation Apparatus

In an apparatus of the "subaeration" type having a vertically driven agitator the ore pulp is delivered to the zone of minimum pressure beneath the agitator, whereby a more stable froth is obtained. In the form of cell shown in Fig. 1 the ore pulp is delivered beneath the false bottom A, if necessary together with air from the nozzle W, and passes through the agitator B, the baffles G, and the grids H; the froth overflows at the weir K assisted by the paddle T, while the residues pass to the next cell by the outlet L, the weir M, and the passage P. See Patent No. 253,618 (Minerals Separation, Ltd., from Minerals Separation N. American Co.), dated March 20, 1925.



253,618

Alloys

ACCORDING to a patent application by the International Nickel Co., New York, U.S.A., aluminium-copper-nickel alloys are produced by adding an aluminium alloy containing not more than about 85 per cent. of aluminium to a molten alloy of copper and nickel. Thus in producing such an alloy containing up to 17 per cent. of aluminium an alloy containing 60 to 70 per cent. of aluminium, 20 to 25 per cent. of nickel and 10 to 15 per cent. of copper is added to the molten copper-nickel alloy. The aluminium alloy may contain magnesium and also calcium, zinc, tungsten, and other deoxidising elements. See Patent application No. 253,879, having the International Convention date June 16, 1925.

In a patent application by H. Yoshikawa of Tokyo, the production of lead alloys containing up to 10 per cent. of bismuth, but preferably 0.25 to 2.5 per cent., is described. See Patent application No. 253,920, having the International Convention date June 21, 1925.

Electrolytic Processes

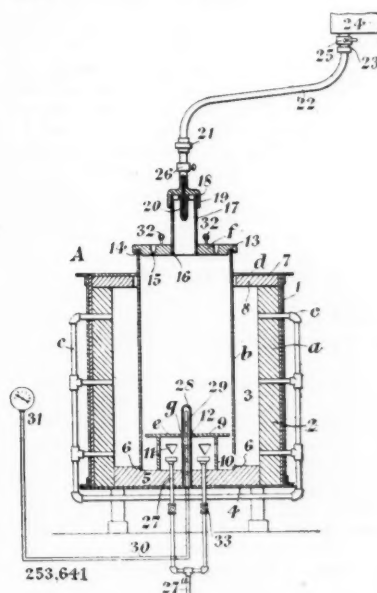
THE waste material from lead smelting works containing lead and tin and a proportion of certain other metals such as copper, arsenic and antimony, is made the anode of an electrolytic cell, the electrolyte being such that only the lead and tin are deposited as an alloy on the cathode, while the other metals remain as a sludge or mass. Such an electrolyte consists of an acid solution of the lead salt of hydrofluosilicic acid or perchloric acid; the cathode consists of electrolytic lead. According to one example the material has the percentage composition tin 45, antimony 10, copper 4, arsenic 0.8, lead 40, iron and sulphur 0.2; the resulting cathode deposit contains tin 63.2, antimony 0.2, and lead 36.6, with no arsenic and only traces of copper; the anode residue contains tin 21.7, antimony 48.2, arsenic 1.1, copper 11, and lead 2.2.

See Patent application No. 253,908 (M. Speichert, Berlin), having the International Convention date June 17, 1925.

According to a patent application by Guggenheim Bros., New York, U.S.A., the leaching of stanniferous minerals is effected with a solution containing tin and (ferrous) iron compounds and hydrochloric acid. The solution is then electrolysed in a cell without a diaphragm, using a graphite anode and tin or other metal cathode; tin is thus deposited and the leaching solution at the same time regenerated; the ferrous chloride present acts as a depolariser, and is stated to reduce the voltage required from 3.0 to 1.4. The residues from the first leaching are further leached with a solvent containing ferric chloride, which may be made by electrolysing the first mentioned leaching solution in a diaphragm cell or by passing chlorine into it; the extract is then electrolysed as before, but in a diaphragm cell, to deposit tin, and the spent catholyte is circulated through the anode compartment to regenerate the leaching solution containing ferric chloride. Bismuth and antimony are also extracted by the second leaching and accumulate in the solvent from which they may be obtained by cementation on tin.

Cementation of Iron

W. H. FISHER and P. Chambers, of California, U.S.A., describe an apparatus for the cementation of iron, etc., by means of organic oils such as pine tar, or fish or vegetable oils. The iron articles are contained in a retort *b* surrounded by a casing *1*, *2*, and heated by gas from the pipes *c*; the oil is admitted through the nozzle *20*, which is arranged so that the entering liquid oil does not come into contact with the hot sides of the retort. See Patent No. 253,641, dated March 30, 1925.



253,641

Stainless Iron and Steel

WHEN making stainless iron or steel by adding a mixture of chrome ore and a reducing agent such as aluminium-silicon to a bath of molten iron covered by slag it is usual to work with an electric furnace, since it is difficult otherwise to supply sufficient heat to keep the mass fluid. It is now found that a basic open hearth furnace may be used if a large amount of slag is present to hold a supply of heat, together with sufficient iron oxide to reduce the carbon content of the iron to 0.08 per cent. and to flux the slag. A preheated mixture of chromite ore and reducing agent (ferrosilicon in an example) is then added slowly, whereupon reduction occurs and the chromium passes downward into the slag. If desired a part of the metal may be run off from an ordinary basic open hearth melt, the necessary adjustment made as to the amount of lime and iron oxide in the slag, and the mixture of chrome ore and reducing agent added. See Patent No. 254,762 (W. Johnson, Fallowfield, Manchester), having the date February 6, 1925.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Some sand-cast alloys of aluminium containing cobalt. S. Daniels. *Metal Ind. (Lond.)*, August 20, 1926, pp. 169-170 and August 27, 1926, pp. 189-190.

Molybdenum as an alloying element. J. D. Cutter. *Blast Furnace and Steel Plant*, August, 1926, pp. 365-366.

Zinc-cadmium alloys. N. F. Budgen. *Brass World*, July, 1926, pp. 223-224.

Production of high chromium alloy steel. R. S. Kerns. *Blast Furnace and Steel Plant*, August, 1926, pp. 334-336.

ALUMINIUM.—The importance of silicon in the hardening of aluminium by lithium or magnesium. P. Assmann. *Z. Metallkunde*, August, 1926, pp. 256-260 (in German).

The protection of aluminium and its alloys against corrosion by anodic oxidation. G. D. Bengough and H. Sutton. *Engineering*, August 27, 1926, pp. 274-277.

ANALYSIS.—Colour reactions and their application in quantitative chemical analysis. H. Freund. *Metall. u. Erz*, August (2), 1926, pp. 444-446 (in German). Describes the estimation of many metals and metalloids.

The determination of oxygen in iron. P. Oberhoffer. *Stahl u. Eisen*, August 5, 1926, pp. 1045-1049 (in German).

CORROSION.—The corrosion and rusting of steel and cast iron Part II. R. Girard. *Rev. Métallurgie*, July, 1926, pp. 407-417 (in French). Discusses the action of salt solutions on ferrous metals.

Protective coatings for metals. Part III. J. A. Aupperle. *Blast Furnace and Steel Plant*, August, 1926, pp. 341-343 and 357. Various methods for protection against corrosion and oxidation.

IRON AND STEEL.—The rational use of carburising materials. Practical results of systematic cementation experiments. J. Hébert. *La Technique Moderne*, August, 1926, pp. 481-491 (in French).

The spheroidising of cementite. B. Stoughton and R. D. Billinger. *J. Ind. Eng. Chem.*, August, 1926, pp. 785-788. A study of certain heat-treated steels.

Resistant steels for chemical engineering. W. H. Hatfield. *J.S.C.I.*, August 13, 1926, pp. 568-573.

The effect of occluded hydrogen on the tensile strength of iron. L. B. Pfeil. *Roy. Soc. Proc.*, August, 1926, pp. 182-195.

The theories of the tempering of steel. Part I. A. Sauveur. *Rev. Métallurgie*, July, 1926, pp. 392-406 (in French).

Chemically resistant steels. Part II. G. T. Elliot and G. B. Willey. *Metal Ind. (Lond.)*, August 6, 1926, pp. 134-135 and August 13, 1926, p. 156. Deals in these articles with low-temperature steels.

Hardness and toughness of high speed steel as affected by heat treatment. R. K. Barry. *Trans. Amer. Soc. Steel Treating*, August, 1926, pp. 257-265.

Heterogeneity of steel ingots and sound steel. R. Hadfield. *Metallurgist*, August 27, 1926, pp. 119-124.

Ghost lines in steel. H. Brearley. *Metallurgist*, August 27, 1926, pp. 116-119.

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Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

BARROW HÆMATITE STEEL CO., LTD.—Registered August 4. Trust Deed dated July 29, 1926 (supplemental to Trust Deeds dated June 10, 1919, and November 8, 1919), securing £219,607 further first debenture stock redeemable at a premium of 2½ per cent.; charged on property and assets of company comprised in charges created by original Trust Deed. *£878,272. March 12, 1926.

HENDY HÆMATITE IRON ORE CO., LTD., Pontypidd. —Registered July 28, £500 debentures, part of £10,000; general charge. *£11,859. March 8, 1926.

SHEEPBRIDGE COAL AND IRON CO., LTD.—Registered August 5, £200 and £600 debentures, part of £750,000; general charge (except certain property). *£531,950. October 12, 1925.

WILLCOCKS (H. S.) AND CO., LTD., Manchester, meta merchants.—Registered August 10, £6,600 debenture to E. E. Smith, 83, Mosley Street, Manchester, solicitor, and another; general charge. *Nil. December 31, 1925.

YORKSHIRE IRON AND COAL CO., LTD., Leeds.—Registered August 3. £120,000 (not ex.) debenture to Bank of Liverpool and Martins Ltd.; general charge. *£117,465 4s. 6d. June 11, 1925.

Satisfactions

BARROW HÆMATITE STEEL CO., LTD.—Satisfactions registered July 27, £219,607, part of amounts registered June 30, 1919, and November 18, 1919.

MARBELLA IRON ORE CO., LTD., London, E.C.—Satisfaction registered August 12, £40,000, registered June 17, 1922.

YORKSHIRE IRON AND COAL CO., LTD., Leeds.—Satisfactions registered August 3, £25,000, registered July 11, 1905; also registered August 6, £30,000, registered April 20, 1904.

U.S. Manganese Production

The shipments of high-grade manganese ore containing 35 per cent. or more of manganese from the mines in the United States in 1925, made a large increase over the shipments in 1924. The shipments in 1925 by 42 producers amounted to 98,324 gross tons, as compared with 56,515 gross tons by 39 in 1924, showing an increase of 74 per cent. This increase was due to the shipments from Montana. This state produced considerably more high-grade manganese ore than all the other states combined, the Butte District having furnished 47,507 tons of rhodochrosite, which was utilised mainly in the manufacture of ferro-manganese. Shipments from this district are not regular year by year, and occur only when a considerable tonnage has been developed through the mining of the zinc ore. The shipments of domestic ore containing 10 to 35 per cent. manganese (ferruginous manganese ore) decreased in 1925 from 286,470 tons, valued at \$929,390, to 267,252 tons, valued at \$915,316. This decrease is due to the falling off of production in Colorado and Minnesota, whereas in Michigan and New Mexico decided increases were made. The domestic shipments of ore containing from 5 to 10 per cent. manganese in 1925 were approximately 100 per cent. greater than in 1924. This increase is due to more extensive use of ores of this grade (manganiferous iron ores) in the manufacture of pig iron containing small percentages of manganese. It would appear that the demand for ore of this character continues to increase.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

The Metallurgy and Uses of Bismuth

By G. Malcolm Dyson, Ph.D., A.I.C.

In a recent issue of this supplement Dr. Dyson discussed the metals zirconium and hafnium. On other occasions he has dealt with a number of other metals, and the series is continued by the article published below.

BISMUTH, as the metal, does not find very extensive use in the arts, since even its most extensively used alloys are required in only comparatively small quantities. The salts of bismuth are, however, comparatively widely used, both in medicine and industrial chemical technology, and it is with no surprise that one learns that 80 per cent. of commercial bismuth is used in the non-metallic state.

Bismuth is not abundantly distributed in nature, and although quite a number of specimens of metallic bismuth have from time to time been found native, the usual source of the metal is among the highly complex sulphide ores. The rarity of occurrence of the ore and the complexity of the ore when obtained account for the extremely high price of the metal. It is interesting to note, in passing, the curious general impression among chemists (engendered possibly by a careful study of analysis tables) that bismuth and cadmium are common metals, while titanium, tungsten and vanadium are comparatively rare; in actual fact, the reverse is true.

Bismuth Ores

The native bismuth referred to above is found among the cobalt and tin measures in Hungary, Norway, and Sweden, and also to a very slight extent among the English stream tin beds. The oxide Bi_2O_3 , although by no means abundant, is commoner than the native metal. Among the less common ores we may mention:

Agricolite	$\text{Bi}_2\text{Fe}_4(\text{SiO}_4)_4$
Eulytin	$\text{Bi}_4(\text{SiO}_4)_3$
Bismuth ochre	Bi_2O_3
Bismuth, cobalt and nickel pyrites	

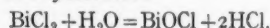
The chief ore, however, is the sulphide bismuth glance (Bi_2S_3). This ore is found to a considerable extent in S. America, where the San Gregorio mine still leads the way in production, and also in Tasmania, where it is associated with pyrites, magnetite, and molybdenite. In Western Australia, principally at Windham, a fair amount of sulphide ore is found associated with molybdenum ores, and extensive deposits occur in S. China (Kuangtung) where, in spite of the primitive methods of extraction, £20,000 worth of bismuth was produced in 1919.

Much of the bismuth of commerce is obtained as a by-product in the smelting of other metals, especially cobalt, nickel, and antimony. In this connection it is of interest that the U.S. Smelting, Refining and Mining Co., and the American Smelting and Refining Co., Omaha, produced in 1913 about 170,000 lb. of metallic bismuth as a by-product.

Extraction

Preliminary sorting of the ore by hand picking is applied in the usual way to bismuth ores, but in some of the more complex ores the preliminary treatment corresponds with that required for the separation of the preponderant metal. This is especially the case with tin ores. In some of the Tasmanian ores which contain magnetite, tinstone, and tungsten ores as well as bismuth, a whole series of mechanical separations is effected before any metal is extracted. The magnetite is removed by separation in a weak magnetic field, and the tungsten ore by subsequent treatment with a very strong magnetic field. The tin and bismuth can then be separated by a system of flotation.

The use of chemical separations for concentrating the bismuth in the various ores has been in vogue for some time, and a variety of chemical processes have been devised by which a fairly pure bismuth compound can be prepared from the ore. An important feature of this form of separation is its use for the separation of silver-lead-bismuth alloys produced in certain smelting operations where the primary object is the silver. Both lead and bismuth are separated from the silver during cupellation, but no sharp separation of lead oxide from bismuth oxide is possible during the operation. Consequently large quantities of the mixed oxides of lead and bismuth accumulate which are most economically separated by chemical means. The actual method used for this separation is extraction with hydrochloric acid. Sufficient of the concentrated commercial acid is placed together with the mixed dross in glazed earthenware pots about 80 by 100 cm. in size, completely to convert the oxides to chlorides. Hot water to the extent of one-third of the acid used is added, and the mixture allowed to stand for several hours during which the conversion to the chlorides takes place. The insoluble lead chloride remains behind, while bismuth chloride goes into solution together with a very small quantity of the lead salt. On pouring into a considerable amount of water the lead salt remains in solution, but the bismuth is precipitated as the oxychloride:

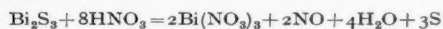


In order to avoid re-solution of some of the oxychloride by the hydrochloric acid production in this operation, sufficient milk of lime is added after the precipitation to ensure neutrality. In this way the whole of the bismuth is obtained in the form of a comparatively pure oxychloride.

Interesting also is the chemical extraction process used in Norway by the Norsk Hydro-Electrisk Kvaestof Aktieselskab. for the simultaneous neutralisation of crude nitric acid and the production of bismuth salts. The impure dilute nitric acid obtained by passing nitrous fumes into water is used as the solvent. If the bismuth ore consists principally of the oxide, then the action of the acid is simply that of neutralisation:



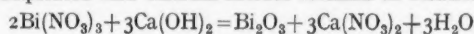
but in the case of the sulphide ore the mechanism of solution is more complicated, since both free sulphur and nitric oxide are formed:



which is, in reality, the summation of the three reactions:

- i. $\text{Bi}_2\text{S}_3 + 6\text{HNO}_3 = 3\text{Bi}(\text{NO}_3)_3 + 3\text{H}_2\text{S}$
- ii. $3\text{H}_2\text{S} + 2\text{HNO}_3 = 3\text{S} + 2\text{NO} + 4\text{H}_2\text{O}$
- iii. $\text{NO} + \text{O} = \text{NO}_2$

The sulphide is roasted slightly, ground finely, and thrown into the crude nitric acid. When the acid is almost completely neutralised the lye is removed and concentrated by means of the waste heat of the electric furnaces. The concentrated solution is then poured into milk of lime, when bismuth oxide is precipitated and calcium nitrate remains in solution:



The yellow Chinese ores are amenable to chemical treatment

for the extraction of their bismuth. Their average constitution, according to E. R. Darling, is:

Bismuth oxide	58 per cent.
Antimony	5 "
Arsenic	0.14 "
Gangue	36.85 "

The ore is ground to about 80 mesh and the fine powder warmed with moderately concentrated hydrochloric acid. The filtered liquor is precipitated with iron swarf, and consists of antimony and bismuth, the arsenic remaining in solution. The well-washed and dried metals are gently calcined when the oxides are formed, and on solution in hydrochloric acid, and precipitation by extensive dilution with water the bismuth is alone obtained in the precipitate.

Smelting for the Metal

In the early days of bismuth smelting, only the high grade sulphide ores were used, and in nearly every case these were further concentrated before smelting by the process known as "liqumtion."

In this operation the sulphide ore was heated in slightly sloping iron tubes when the sulphide melted and drained off and was by this means obtained in a comparatively pure state. The method is wasteful since the residues contain from 5 to 10 per cent. of bismuth which in the older variations of the process was thrown away. In actual practice nowadays it is usual to convert poor ores to the oxide by chemical means, and reduce this with iron. In the case of rich sulphide ores a variety of methods for their treatment remains available, but one of the more usual is to liquate for pure sulphide, which is reduced with iron in the usual way, and to work up the bismuth in the liqumtion residues chemically. The reduction of the oxide or sulphide with iron scrap is a simple but very economical operation. In one actual run the following ingredients were heated together in a clay crucible on the furnace hearth:—

Sulphide ore (containing 240 lb. Bi)	2,000 lb.
Soda	1,300 lb.
Iron scrap	550 lb.
Sodium nitrate	50 lb.

and from this charge 230 lb. of bismuth was obtained. In another process in which oxide crudes were smelted with coal the following charge:—

Oxide crudes (containing 450 lb. Bi)	2,500 lb.
Soda	2,300 lb.
Slag (containing a fairly high percentage of Bi)	1,000 lb.
Ground coal	150 lb.

yielded 452 lb. of bismuth; a fact which points to the conclusion that once a suitable fluxing slag is obtained the smelting of bismuth is a very economical operation. Such reductions are best carried out in kilns heated with producer-gas, but considerable care has to be taken in order to regulate the temperature within the comparatively narrow limits necessary for the highest yield of metal. Producer-gas is obtained in the kiln and fed through flues into the several chambers arranged in line behind the kiln. It escapes through chequer firebrick into the actual chambers and burns to give the necessary heat. The pots are usually run in on the usual trolley-rails and removed for removal of the reduced charge in the same way.

The Purification of Bismuth

The principal impurities in the crude bismuth obtained in the operations described above are arsenic, antimony, and lead. The removal of these is not of great importance when the bismuth is destined for use in alloys, but it is of paramount importance to remove them when the bismuth is intended for conversion into pharmaceutical products. Consequently a variety of methods has been proposed for the dry purification of bismuth. An average specimen of crude bismuth gave the following analysis:—

Bismuth	98.50
Iron	0.02
Copper	0.03
Lead	0.30
Silver	0.01
Antimony	0.72
Arsenic	0.31

Among the dry methods of purification the fusion process is the oldest and most popular. The bismuth is fused in a cast iron pot set in a producer-gas furnace (Fig. 1), and when its temperature has reached 300–400° C. a quantity of caustic soda is added to the pot followed at intervals by small quantities of sodium nitrate. In this way the lead is converted to the oxide, and the arsenic and antimony form sodium antimonate and arsenate. The great disadvantage which attaches to the process is the rapidity and ease with which the bismuth is slagged away. This is in the main part due to the oxidation of part of the lead to the peroxide PbO_2 , which then reacts with the caustic soda to give Na_2PbO_4 , which is an extremely strong oxidising agent, oxidising the bismuth to bismuth oxide, and leaving lead oxide ready to repeat the cycle of operations.

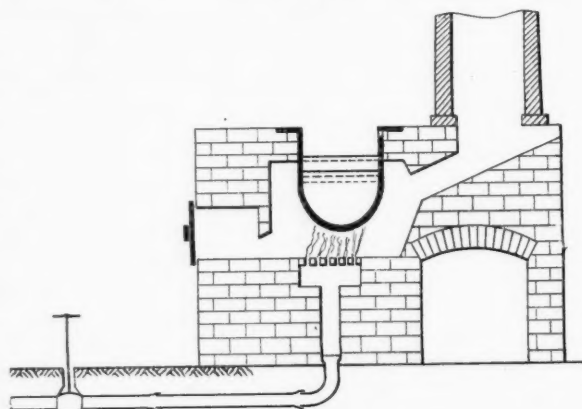


FIG. 1.

Other methods of purification in the dry way, which do not cause the intense slagging of the metal, consist in fusion of the crude metal in the presence of the oxychloride, and with a small proportion of sodium hydroxide and chloride. Bismuth purified by this method has the property of "starring" on cooling, a physical phenomena due to the large and glistening crystal faces formed on the sides of the ingot. The oxychloride may be substituted by bismuth sulphide, but it is doubtful if this method gives as pure a product.

The electrolytic method of refining bismuth was introduced by Zahorski. The crude metal forms the anode in a bath of dilute nitric acid and the pure metal is deposited at the cathode by a current whose density is 300 amps./sq. metre. The deposit of bismuth is washed with dilute nitric acid and melted down. The process is not so satisfactory as the more modern process introduced by Betts, in which the strength of the electrolytic bath is so adjusted that it contains about 7 per cent. of bismuth and 9 per cent. of HCl. The current is so arranged that the density per sq. metre is 600 amps. at the anode and 200 at the cathode. To obtain a brilliant and very coherent layer of metallic bismuth the electrolysis of a 4 per cent. solution of bismuth methyl sulphate in a 10 per cent. solution of methyl sulphuric acid is advised.

The Metal and its Alloys

Bismuth crystallises in broad shining plates of a greyish colour which in certain positions appear to have a pink tinge. When slowly cooled, large crystals can be obtained which in reality belong to the rhombohedral system, although the angle is so near 90° that the crystals appear cubic. Bismuth will not crystallise well if contaminated with lead, and if any appreciable percentage of lead is present, then liquid drops will force their way through the crust of metal on cooling, giving the appearance of "sweat." These indications are looked for commercially in the examination of a sample of the metal. Bismuth can be readily obtained in the colloidal state by reducing a solution of the nitrate with stannous chloride or by a strong organic reducing agent in the presence of some stabilising colloid such as protalbinic acid. The colloidal bismuth so obtained is used therapeutically in the treatment of syphilis, in which a large number of bismuth compounds, including those derived from the trialkyl and triaryl compounds, in common with other members of the

family—arsenic and antimony—appear to exert a favourable action.

The alloys of bismuth are metallurgically more interesting and important than the metal itself. Bismuth alloys very readily with nearly all metals, and it is to be remembered as a caution that it readily dissolves platinum. The alloys with nickel with or without other metals, constitute a series of complex "bismuth bronzes" which are distinguished for their singular resistance to the corrosive action of sea-water and air. Among the commonest bismuth bronzes are the following :—

	Bi.	Ni.	Cu.	Zn.	Sb.	Pb.	Sn.
Number 1.	1	309	47	21	—	—	—
Number 2.	1	24	25	—	50	—	—
Number 3.	1	30	52	—	—	5	12

The arsenic alloys of bismuth are curious in that they have very unexpected melting point curves, but practically they call for no comment. The bismuth-lead-tin complexes are those which are most prominent in connection with the alloys of bismuth, as their melting points are very low, some being below 100° C. They find use in the manufacture of automatic fire alarms and sprinkler devices, and in the manufacture of stereotype plates, for which purpose they are

especially suited on account of their expansion on solidification. Among the more commonly known are :—

	M.P.	Bi.	Sn.	Pb.	Sb.	Cd.
Lipowitz	60	50	4	27	—	3
Rose	71	50	25	25	—	—
Cliche	71	9	48	32	14	—
Lichtenberg	91.6	50	20	30	—	—
Newton	94.5	20	30	50	—	—

There is one remaining alloy of bismuth that is worthy of mention ; its constitution is as follows :—

Aluminium	92
Copper	5
Bismuth	2
Silicon	1

The last three constituents are melted together and tipped into the molten aluminium. The alloy is used to a certain extent, especially on the Continent, for the manufacture of resistant vessels for the manufacture and concentration of sulphuric acid, and for the manipulation of strong cyanide solutions.

Chemically bismuth is but slightly called upon. Medically the basic nitrate and carbonate are well known remedies for diarrhoea and the oxide finds use in the preparation of cosmetics.

Causes of Rupture in Lead Pipes

(From a Correspondent)

ALTHOUGH electrolytic effects are often the fundamental cause of holes in cast-iron pipes, they are not responsible to any great extent for the destruction of lead pipes. Iron pipes, on the contrary, are almost immune from the effects of friction and frost, whereas lead pipes are exceedingly susceptible. The effects of high pressure on the lead pipes are too well-known to need discussion here. Little danger of burst pipes is to be expected where a known head of water at a steady pressure is exerted.

When pipes do burst under these conditions it is almost solely due to defective installation. Under ordinary conditions hydrodynamic effects caused by steady pressure should not be sufficient to cause a breakdown in the structure of the lead. The action of the hydraulic ram, however, is an entirely different matter. What are known as "peak pressures" or intermittent pressures due to the momentum which results when a volume of water in motion is suddenly arrested, probably give rise to the most severe action to which lead pipes are subjected. When the pipes have been manufactured from inferior qualities of scrap the effect of the momentum set up is evident.

Effect of Impurities

Certain varieties of lead scrap contain a small proportion of copper which has alloyed, due to the presence of a little tin or antimony. When this lead scrap is refined in kettles or melting pots, tin and antimony are "oxidised out" by the oxidising action of the atmosphere. This results in the copper being left in the lead in a state of mechanical mixture throughout the metal. Even where the copper only amounts to several decimals per cent., the tensile strength of the lead is greatly impaired. This is most evident when pipes made from the impure metal are subjected to intermittent pressure. Even when the pipes have been manufactured from the best qualities of prepared lead, the action of suddenly stopping a rapid flow of water is liable to produce a weakening, if not a yielding, of the metal in time.

The weakest part of the pipe is soon located by the water which, not being compressible, will be unable to cushion the impact, resulting in an expansion or fracture. Little can be done by way of reducing the effects of the action of the hydraulic ram. If, instead of using ordinary taps, valves which could be gradually screwed down were employed, the risks of sudden high pressures would be greatly lessened and the cause of many breakages remedied. Any yielding or expansion of the pipes is equivalent to a reduction in the thickness of the metal at that particular point. A great deal

of trouble would be saved if pipes which had been thinned were replaced before the expansion had proceeded too far.

Regarding the effects of frost on the water in lead pipes, somewhat similar conditions prevail. Water has a greater density than ice, and therefore, at the moment of solidification, expansion takes place. As a general rule the water suddenly freezes throughout the length of the pipe. If no space exists to allow of expansion then the pipe must meet the increase in volume, frequently causing a burst. The impurities, tin, antimony, and copper, impair the resistance of lead pipes to frost. These impurities, if present in too large a proportion, cause undue hardening of the lead. The percentages of impurities are seldom uniform, the composition of one pipe often differing considerably from that of another. Moreover, the amount of copper held in a state of mechanical mixture rests on the amount of oxidation which has affected the tin and antimony. On the other hand, the benefits secured by the inclusion of a certain proportion of tin and antimony to lead in the manufacture of pipes must not be overlooked, as the tensile strength of the metal is increased, although the malleability is diminished.

A remedy against the freezing of water in pipes during the winter months (where the liquid is not to be used for drinking purposes) is to add a small proportion of glycerine. This would become a costly matter if much water were employed, but is of value where the same water is used repeatedly. As regards the damage due to friction, this is generally noticed where the pipes are directly connected to some form of pump. The pulsation of the pump which feeds the pipes is only indirectly responsible for the friction set up, insecure fixing of the pipes being a more common cause. Continual vibration of heavy machinery is not without its effects on lead pipes. In many works the results of friction are confused with those caused by corrosion. Friction certainly weakens the metal, but is seldom recorded as being directly responsible for the bursting of pipes. One point, however, which is regularly overlooked is that vibration of liquids which are cooling near freezing point will produce solidification which otherwise would not have occurred. Vibration in this sense is a danger and should be avoided as far as possible.

It might be mentioned, in conclusion, that pipes which are slightly flattened are claimed to withstand the effects of pressure, or frost, as the walls of the pipe do not enclose the largest possible area, and are therefore able to expand without weakening the metal. This point has, however, been disputed by several authorities, who state that the shape should not materially alter the resistance to pressure.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Institute of Metals Programme

THE programme of the Institute of Metals for the session 1926-27, dating from October 1, has just been issued. It covers not only the work of the parent institute, but also that of its six local sections centred in various metallurgical districts. Over forty lectures, dealing with various phases of metallurgy, are enumerated in the programme; these include the annual May lecture, to be delivered by Sir Henry A. Miers, F.R.S. Copies of the programme can be obtained from the secretary, Mr. G. Shaw Scott, M.Sc., 36-38, Victoria Street, London, S.W.1, who is also able to supply—at 2s. 6d. each—copies of any of the sixteen papers read at the recent Liège meeting of the Institute.

Light Metals and Alloys

NOTHING in modern metallurgy and engineering is more remarkable than the enormous development of the use of aluminium and its alloys, and of the magnesium-containing metals, in constructions in which, until a decade or so ago, nothing but iron, steel, brass, or nickel were ever employed. The name of the light alloys is now legion and as they almost all have proprietary names which convey literally nothing as to their composition and properties, a state of chaos exists in their nomenclature. Amongst the latest comers are, of course, Alpac (which is "modified" by the use of sodium salts, and the proprietors of which have permitted the publication of certain interesting details as to mode of preparation) and Lantal; to both of which reference has already been made in these columns. To these have now to be added a new German alloy, "Montago," which is described as belonging to the "lighter than duralumin" group and therefore, presumably, contains magnesium in larger proportions than that metal, and a new French alloy called "Aldal," which is being placed on the market by the Duralumin Company, of Paris, for use where Duralumin patents do not run. It contains "about" 3.4 per cent. of copper, 0.42 per cent. of magnesium, and 0.41 per cent. of manganese, and is "contaminated" with silicon. Details respecting "Montago" have not yet been worked out, and the special treatment capable of bringing out its best mechanical properties is still under investigation.

Ageing Phenomena

THERE seems little doubt, by now, that ageing, or age-hardening in the light alloys containing magnesium, is due to the presence of the magnesium. In the manufacture of electrical cables it is a factor to be reckoned with. Its effect, when it occurs at ordinary, or "room" temperature, differs considerably from what is called artificial ageing, due to heating at 100° or 200° C. In the former case the conductivity decreases; in the latter it increases to a considerable and useful extent. The practice to be employed for artificial ageing differs very considerably as regards different alloys, and the presence of metals other than aluminium and magnesium, such, for instance as zinc, copper, beryllium, and lithium, either with or without magnesium, complicates the processes employed, which, for the most part, are the subjects of innumerable patents. This seems to indicate that while magnesium, when present, may be the main factor in inducing ageing effects, it is not the only one. Generally speaking, the purer a metal the greater its electrical conductivity. There are indications—they are scarcely more than that—that occluded gases, either in solution or, as is usually the case in oxygen contamination, as oxide particles, act more adversely on the electrical conductivity of an otherwise "pure" metal, than the presence of other metals, in solid solution. If this be so the improved conductivity at certain temperatures of metals which display this particular ageing phenomena may be due to the part played by the added metals in removing or facilitating the removal of the oxygen, and perhaps of other gases, such as nitrogen, as well. The classical explanation at present is that it is caused by the behaviour of Mg₂Si present, and its differential solubility at varying temperatures. The whole matter is bound up with the question of resistance to corrosion, which again is higher in pure metals than in metals contaminated, or alloyed, with others.

A "Pure Iron" Pipe Line

THE connection between the ageing of light alloys and the relative behaviour of alloys and pure metals to corrosion, and the recent placing in this country of the famous £500,000 contract for ingot iron pipes for Sao Paulo, is not really far to seek. The link is of course the growing preference displayed by engineers and others for pure iron. Ingot iron is a more expensive material than wrought iron, or cast iron, and its selection for the water pipes in question, in preference to steel pipes, will renew the old, old controversy as to the relative rust-resisting properties of the four types of metal involved. The battle used to rage between wrought, cast iron, and steel only; the intrusion of "ingot iron," that stumbling block in ferrous nomenclature, has really clarified, rather than obscured, the issues. The evidence in favour of the superior resistance of ingot iron is accumulating rapidly. As recently as 1923, Dr. Newton Friend, who has made the fascinating investigation of the corrosion of ferrous materials peculiarly his own, published some significant results obtained in experiments as to the relative behaviour of "commercially pure iron," wrought iron, carbon steel, special steel, cast iron, and nickel. On the score of expense a pipe line 80 kilometres in length, such as that to be laid in Sao Paulo, could not obviously be made of special steel, or of nickel. Omitting, therefore, these categories, the figures found by Dr. Friend for the relative corrodibility of "commercially pure iron," wrought iron, carbon steel, and cast iron need alone be quoted in this connection.

Relative Corrodibilities

THE figures given by Dr. Friend are shown below:—

RELATIVE LOSS IN GRAMS.			
A and B: Four months' continuous immersion in tap water and artificial sea water respectively. C: 22 hours' immersion in 0.5 per cent. H ₂ SO ₄ .			
	A	B	C
Commercially pure iron	96.0	79.6	76.1
Wrought iron	104.5	85.7	461.3
Carbon steel	102.7	87.9	231.3
Cast iron	110.3	86.4	1325.6

In reviewing the results he says:—"The commercially pure iron is highly resistant to acid attack and quite as resistant to neutral corrosion as the wrought irons." The figures, which speak for themselves, would appear to have warranted an even more emphatic statement. "Commercially pure iron" which is, of course, another name for ingot iron, is more expensive to produce than ordinary steel or wrought iron, as the charges take longer to work and all incidental expenses pile up. Moreover, the higher temperature of working entails shorter life and heavier repairs to the furnace. This notwithstanding, the contract, which has come as a godsend to our depressed iron and steel industries, has stipulated that the more expensive metal is to be used. It will be cheaper in the long run.

Sulphur in Non-Ferrous Metals

THE deleterious influence of sulphur extends to practically every commercially useful metal. It has been shown in a striking manner by some figures published last month by Meigen and Schroer in the *Centralblatt der Hutten und Walzwerke*. In pure copper, the addition of a little over three-quarters of 1 per cent. reduced the tensile strength by no less than 70 per cent. In other metals the noxious influence of the sulphur was not so great, although in some of the brass metals and in tombac it exerts a very prejudicial effect. Less than half of 1 per cent. reduced the strength of a 77:20 brass by 53 per cent.; in the case of a bronze containing 94 per cent. of copper and 3 per cent. of zinc, with nearly 1 per cent. of tin and a little over 1 per cent. of lead, the tensile strength was reduced nearly 40 per cent. by the addition of 0.7 per cent. of sulphur. A 99.7 per cent. pure zinc, and a 99.39 per cent. pure tin, lost 25 and 41 per cent. of their original tensile strength on the addition of 0.3 and 0.6 per cent. of sulphur respectively. A lead containing 99.57 per cent. Pb and 0.43 per cent. of sulphur fell from 1.9 tons tensile strength per

square inch to 1:1 or over 26 per cent. It would appear that sulphur is even more objectionable in non-ferrous metallurgy than in that of iron and steel, where its bad influence is often masked by the addition of manganese.

New Metals in South Africa

HITHERTO the mineral wealth of the Union of South Africa has displayed at least two important gaps, although it has for some time past been anticipated, on sound mineralogical and geological grounds, that these gaps would be filled. The missing metals were molybdenum and cobalt. The latest news is to the effect that a very valuable deposit of molybdenum ore has been located in what is, to all appearances, a narrow fissure on the border line between the red granite and the norites of the "Bushveld complex." On opening up, this fissure has been proved to be wider than was expected, having widths of from 15 to 20 ft., extending for a distance of a mile or so. In addition to molybdenum, cobalt and zinc ores have been found. The molybdenum deposit is said to be extraordinarily rich, containing, as it does, 11 per cent. of molybdenum, and as the payable percentage of molybdenum concentrate is comparable with that of tin, an average content of no more than half the amount indicated by the analysis would prove highly profitable. What with gold and platinum on the Rand, the mineral resources of South Africa are rich indeed, while the rest of Africa bids fair to be a perfect treasure house of mineral wealth. Both Nigeria and the Gold Coast possess rich deposits of tin ore; manganese abounds in West Africa; the copper deposits of Katanga, and of the Congo generally, are famous; beryl is fairly plentiful in South Africa, and of late very valuable alluvial gold and platinum deposits have been discovered and are being washed in Abyssinia. The minerals of the latter country are not by any means fully exploited, and there are indications that it is far richer than even the fabled tales of Ethiopia of old would have led one to suspect.

The Spanish Customs Duties

A GREAT deal of discussion has been aroused by the action of the Spanish authorities in increasing the tariff on imported iron and steel and manufactures thereof by 20 per cent., and in prohibiting entirely the import of iron and steel except by manufacturers, who will not be allowed to carry any stocks. As regards fine carbon steels, including alloy and high-speed steels, this threatens Sheffield with the destruction of an export market worth £200,000 per year in actual contracts. The Spanish regulations above mentioned, together with certain others affecting other classes of goods, came into force in July. In the House of Commons, on Monday, Sir P. Cunliffe-Lister (President of the Board of Trade), answering a question by Mr. Ramsden, stated that the Spanish Government by a Decree of July 9 increased the duties payable on the importation of certain goods, mainly textiles, metals and machinery. These increases would not, so far as United Kingdom goods were concerned, apply to such of the goods as were specifically included in the schedules to the Anglo-Spanish Commercial Treaty and other commercial treaties in force. The restrictions on import, which were imposed by the same Decree, mainly affected iron and steel goods, and strong representations had been addressed to the Spanish Government against the restrictions which, in the opinion of His Majesty's Government, were in conflict with the spirit of their Treaty. The Spanish Government on August 6 and 12 and September 8 issued Decrees somewhat mitigating the rigour of the restrictions, but he was still awaiting a reply to their general representations and would consider what action might be possible in the light of the reply.

Refractories in Metallurgy of Zinc

IN co-operation with the Missouri School of Mines and Metallurgy, the Bureau of Mines, Department of Commerce, is conducting a study of the requirements of refractories for zinc smelting, of the refractory materials that meet these requirements and of the location of deposits of suitable fireclays or other refractory materials, in an endeavour to find ways of improving the quality of the retorts, condensers and furnaces used for zinc smelting. The cost of refractories,

especially for retorts and condensers, is a large item in the cost of smelting zinc ores. The specifications which a fireclay must meet in order to be suitable for zinc smelting are very strict. The first phase of the investigation consists in determining properties of fireclays now used for comparison in testing new materials. Samples of the materials being used for retorts at a number of smelters have been collected and tests of refractory properties on these samples have been completed. Chemical analyses have also been completed and this phase of the investigation will be completed in the current year. The second phase of the investigation includes similar tests of new materials.

Castings in "Era" Steel

THERE was read at the recent Chemical Congress in London, a valuable paper on chemically resistant steels, by Messrs. T. G. Elliot, F.I.C. and G. B. Willey, F.I.C., A.R.S.M., members of the Research Department of Hadfields, Ltd., Sheffield. These steels, known under the brand and trade mark term "Era/CR" Non-corroding Steels, were recently examined and tested very severely both chemically and mechanically by one of the largest chemical works in this country. These users, we understand, were exceedingly pleased with the behaviour of the material, both as regards non-rusting and non-corroding, and found the Hadfield products when subjected to machine work, including drilling and planing, as well as caulking and autogenous welding, to be superior to the products they had hitherto tested. The accompanying photographs show interesting products made out of "Era/CR" steel. The medallion of Robert Boyle, one of a series cast by Hadfields, is a fine example of very deep stamped work and illustrates the high quality and malleability of the material. The fluid steel from which the castings were made possesses



the high temperature of about 1,450° C. (2,642° F.), yet sharp, clear impressions have been obtained—a result usually difficult to accomplish. The goblet shown is 8 inches in depth, which is a remarkable stamping and drawing feat to accomplish in this non-corroding steel, especially when it is borne in mind that the tensile strength is no less than 45–55 tons per square inch.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

ALTHOUGH five months have now elapsed since the officials of the Miners' Federation called the men out, there is no indication that they have repented of their action. Surely the failure of the general strike ought to have shown them that they could not hope to impose their will on the nation. As to the miners, five months' wages have been lost, and they are faced with the fact that whenever work is resumed it will be on terms considerably worse than they could have had if they had remained at work or even if they had agreed to a settlement on the lines which were offered in the earlier part of the stoppage. The owners seem determined not to have a national agreement. District settlements with either longer hours or reduced wages, or in some cases both, will probably be the terms of settlement.

Cost of the Strike

The newspapers recently have been giving various estimates of the loss occasioned by the coal strike. The President of the Board of Trade a few days ago put the direct loss at about 200 million pounds, in addition to the indirect loss due to the cancellation and diversion of contracts, etc. Whatever the amount is, the iron and steel trade is suffering a very considerable share of it. Indeed, if it were possible to get out in round figures what the actual loss is, both in deterioration of plant and in the loss of business, the figures would be staggering. Many of the steel works are uncomfortably near bankruptcy, and it will be a very hard struggle to survive this calamity, coming as it does on the top of five years of acute depression. Nevertheless, some of the works are making a partial start by the use of foreign coal, although such a procedure must increase the loss. Of course, increased prices can be obtained for any steel supplied during the stoppage, as the consumers are only too glad to pay the extra, but this extra price will not cover the increased cost caused by the high price of foreign coal. Several mills are in operation on the North East Coast, and there are some at work in Scotland and in Wales. Guest, Keen and Co. have just re-started some of their plant at Dowlais, giving employment to about 1,000 men who have been out of work since May.

Contracts and Prices

Although in well-informed quarters the opinion is held that the stoppage may last four or six weeks longer, there appears to be an expectation among the general public of a much earlier termination, and this is bringing out many inquiries for contracts for supplies after the strike, both for steel from the steel works and for fuel for the works. There is still a disinclination among the steel makers to enter into forward contracts, although here and there one hears of business being booked at current prices. It is also possible to make contracts for coal and coke delivery after the strike, as the owners seem to have decided what their policy will be. Many of them are now willing to book contracts for deliveries up to the end of June at an advance of from 1s. to 3s. per ton on the prices ruling before the stoppage. Short term contracts will not be accepted at this advance. For the first few weeks after the resumption of work coal and coke will be in great demand, and prices may be anything up to 10s. per ton higher; but this condition will not last long, as the supply of coal will soon overtake the demand, particularly as the export market has fallen away so much. Then there will be a rapid fall, and it is not likely that the pre-strike level or even lower will be reached.

As far as the steel trade is concerned, it is no use the colliery owners coming forward with exorbitant prices for coal, as it would simply mean that the works would not be restarted. It is still true that 1s. per ton advance on coals means about 3s. 6d. to 4s. per ton on finished steel, and therefore the steel trade simply cannot face a large advance in the price of fuel. It is, no doubt, for this reason that the collieries are willing to accept a small advance, and the fact that they stipulate the period to extend to the end of June next seems to indicate that they too are expecting coal prices to be comparatively low.

European Steel Cartel

There is still much interest being shown in the proposed European Steel Cartel. There is every probability that the four countries, Germany, France, Belgium, and Luxembourg, will come to an agreement, and although the heads of the movement state that the one object of the syndicate will be to stop the internecine competition, there is no doubt that England, remaining outside, will be subject to a competition as fierce as any that has been previously experienced. In Germany rapid strides are being made towards economic recovery, and that country looks like being once again in a dominant position before very long. The men are working well, and their wages on the whole are about half of those paid in England. The new steel trust, the United Steel Works (Vereinigte Stahlwerke), is an accomplished fact, and although it does not include a preponderance of the productive capacity of Germany, it will play a very important part in controlling the future of the steel trade of that country, and its low costs of production will enable it to make a bid for markets which both England and America will need.

Home Markets

There is still very little to be said about the iron and steel markets at home, as there is very little business being done. Prices remain nominally unchanged. A suggestion was put forward that there should be a further small increase in the official prices for steel; but it was thought advisable not to make any alteration at present. Possibly an advance will be notified later when the strike is settled, as makers will be obliged to make provision for the increased cost of manufacture which will ensue, at any rate for a time.

In addition to the supplies of coal and coke imported from the Continent, there have been rather larger supplies of continental iron and steel. Many of the foundries, unable to obtain pig iron at home, have bought from Luxembourg and Germany, and this has helped them considerably. Steel plates and sections have also been purchased abroad, but there is still trouble in getting delivery. The tendency of continental prices is upwards, and they are getting nearer to the level of English prices.

Recent Contracts

A number of important contracts have been placed during the past few weeks for constructional work, rolling stock, etc., which will be of considerable assistance to the steel works. These, together with the unusually large weight of orders on the books accumulated during the stoppage, are causing an optimistic view of the future. It is quite probable that a satisfactory settlement of the present dispute will be the forerunner of a period of great activity, which will be long enough to give the steel trade the impetus that it needs for the long-expected revival.

The number of blast furnaces in operation at the end of August was six, and the production of pig iron amounted to 13,600 tons. The output of steel ingots and castings was 52,100 tons, which was about 20,000 tons higher than in July. The increase was due to the use of foreign coal, in addition to the extra supplies being raised at home.

An American Hard Surface Steel

It is reported from America that a hard surface steel with a tough and ductile inner core, known as "Jalcose" steel, has been produced by the Jones and Laughlin Steel Corporation. The steel is a product of the open-hearth furnace, and is being exhibited in the form of hot-rolled and cold-finished bars, automobile machinery and other machinery parts at the Exposition of the American Society for Steel Treating, in Chicago. It is said to be of value as a substitute for steel used for machinery, owing to its low cost. In especial, it is suitable for parts of automobile and aeroplane engines, taking the place of alloy steels. Among the claims made for it are extension of the life of cutting tools, increase of drilling speed, and capacity for case-hardening and forging.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Preventing Oxidation

THE oxidation of magnesium and alloys thereof is prevented by treating the metal with a solution of a fluoride, such as sodium fluoride or cryolite, and, after drying, coating with a varnish. The metal may be given a preliminary pickling to remove oxide if present. See Patent application No. 254,302 (I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany), having the International Convention date, June 24, 1925.

Treating Iron Ores

IRON ores, particularly those of low iron content, are treated with chlorine and a carbonaceous reducing agent to convert the iron into ferric chloride which volatilises and is subsequently burned with air or oxygen to produce iron oxide and chlorine; the latter is used again. The materials used must be dry. An apparatus is described in which powdered materials are treated with chlorine in counter-current in an inclined rotary kiln. Non-volatile metal chlorides may be leached from the residues. See Patent No. 255,639 by S. G. S. Dicker (from Kalmus, Comstock, and Westcott, Inc., Boston, Mass., U.S.A.), having the date July 17, 1925.

Extracting Copper

It has been found that copper may be separated by froth-floatation from copper ores which have been treated by the process of specification 250,991 (see THE CHEMICAL AGE, Vol. XV, page 7, Metallurgical Section), so as to cause the copper to come to the outside of the ore particles. It is stated that 90 per cent. of the copper content of the roasted ore can thus be separated. See Patent No. 255,961, by J. C. Moulden and Metals Production, Ltd., London.

Chromium

METALLIC chromium is prepared by smelting in a blast furnace a mixture of a chromium-bearing compound, carbon, and an oxygen-containing compound of sodium; thus a mixture of chromium oxide, coke or charcoal, and sodium carbonate may be used. At the white hot part of the furnace the carbon reduces the sodium compound to metallic sodium, the vapour of which rises to the cooler portions, condenses, and falls back as liquid; a zone of sodium vapour is thus maintained; as the mixture descends the chromium oxide is reduced (reduction taking place at about 800° C.) with formation of the metal and sodium oxide, which latter is again converted into metallic sodium in the lower and hotter parts of the furnace. In the fusion zone a certain amount of chromium carbide is formed, but this can be decomposed by introducing a sodium oxide compound, preferably sodium chromate, with the air blast; this addition also serves to make good the sodium losses which amount to about 4-6 per cent. The chromium is exceptionally free from metalloid impurities. See Patent Specification 256,433, by J. H. Beaumont (from the Metal Research Corporation, New York, U.S.A.), dated October 14, 1925.

Alloys

ACCORDING to a Patent by M. G. Corson, New York, U.S.A., copper alloys of considerable hardness and tensile strength are obtained by the appropriate heat treatment of alloys containing principally copper, together with 0.1 to 1.5 per cent. of silicon and 0.3 to 3 per cent. of iron, or 0.1 to 0.35 per cent. of silicon and 0.3 to 2 per cent. of chromium. The alloys are heated to 950° C. to obtain a uniform solid solution, quenched, and reheated to 450-550° C. See Patent Specification 256,457, dated December 21, 1925.

Alloys containing beryllium and silver with or without other metals are described by the Beryllium Corporation of America. Such alloys, even when containing only about 3 per cent. of beryllium, have the valuable property of remaining untarnished in the presence of sulphur compounds. The alloys, when cast, are somewhat brittle, but can be rendered ductile by working at elevated temperatures and finally annealing. Small amounts, say, 5 to 10 per cent., of silver or aluminium may also be added to beryllium to reduce its hardness and render it more readily workable. The preparation of beryl-

lium-silver alloys is advantageously effected by electrolysis of a beryllium salt, using a silver cathode. According to an example, sodium-beryllium fluoride is electrolysed at 1100 to 1200° C. in a graphite crucible, using a molten silver cathode. See Patent Specification 257,473, having the International Convention date, December 2, 1925.

Magnesium alloys containing aluminium or zinc or both in amounts not less than 3 per cent. and not greater than 20 per cent. are improved by cooling as quickly as possible after casting to 300° C., and maintaining at this temperature for three hours; the ordinary cast blocks may also be heated to 300° C. for several hours. The alloys so treated may then be worked, again heated to 300° C. and quenched. See Patent Application 254,741 by the I.G. Farbenindustrie Akt.-Ges., Germany.

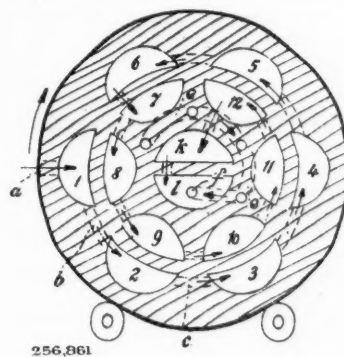
According to a Patent Application by the T. Goldschmidt Akt.-Ges., Essen, Germany, aluminium alloys containing about 5-15 per cent. of silicon and an additional metal are prepared by electrolysis in a fluoride bath of compounds containing the desired constituents. An example is given according to which a mixture of alumina and silica obtained from an aluminium silicate is electrolysed in a fluoride bath, together with a compound containing the third metal, which may be an alkali or alkaline earth metal, chromium, manganese, titanium, vanadium, nickel, or cobalt. See Patent Application 255,103, having the International Convention date, July 10, 1925.

Briquetting Ores

ACCORDING to V. C. Ostlund, of Stockholm, iron ore and other concentrates are advantageously briquetted by using caramelised molasses as the agglutinant. A small quantity only is necessary, the caramelised product from 12 kg. molasses being sufficient for 1,000 kg. ore concentrates. See Patent Specification 256,838, having the International Convention date, October 14, 1925.

Rotary Furnaces

ROTARY furnaces consist of a number of roasting chambers disposed about the axis of rotation and through which the material, particularly zinc blende, passes in turn. Heat produced in the early roasting stages is thus conducted to the adjacent chambers in which a later phase of the roasting is taking place and serves to maintain the temperature thereof. Fig. 1 shows a cross section of one form of furnace. The zinc



blende is introduced at *a* into the helically ribbed chamber 1, travels along the said chamber and returns by the passage 2, in which the pitch of the helical rib or ribs is in the opposite sense; it passes in succession through chambers 4 to 12, *k*, *l*. The passages *c* serve for pre-heating the roasting air which travels through the furnace in the opposite direction to that of the blende. See Patent Specification 256,861, by F. E. J. Enke, Harburg, Elbe, Germany, dated January 30, 1926.

Tin

ACCORDING to H. Harris, London, tin may be freed from arsenic by treating the molten metal with caustic alkali or materials yielding alkali oxide under the conditions of working; an addition of sodium chloride or carbonate, or an oxidising agent, such as sodium nitrate, is sometimes advantageous. The arsenic is converted into sodium arsenate, which dissolves and is removed in the excess of alkali. See Patent Specification 257,023, dated May 20, 1925.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Aluminium-silicon alloys. A. G. C. Gwyer and H. W. L. Phillips. *Metal Ind. (Lond.)*, September 10, 1926, pp. 236-242. A discussion of the constitution and structure of normal and modified alloys.

On the question of the direct production of brass from mixed ores. W. M. Guertler. *Metall u. Erz*, September (1), 1926, pp. 468-472 (in German).

On the formation and properties of red brass. Part I. R. Kühnel. *Z. Metallkunde*, September, 1926, pp. 273-278 (in German). Deals with the influence of impurities and liquidation effects.

Aluminium-cadmium-zinc alloys. N. F. Budgen. *Brass World*, August, 1926, pp. 247-250. A preliminary survey of their mechanical properties.

Some mechanical properties of silicon-aluminium alloys. J. D. Grogan. *Metal Ind. (Lond.)*, September 17, 1926, pp. 269-270 and September 24, 1926, pp. 291-292.

ALUMINIUM.—Fifty years' progress in aluminium. J. D. Edwards. *J. Ind. Eng. Chem.*, September, 1926, pp. 922-924.

ANALYSIS.—The estimation of sulphur in iron. K. K. Järvinen. *Z. anal. Chem.*, No. 11, 1926, pp. 397-404 (in German).

The separation of iridium from iron. W. R. Schoeller. *Analyst*, August, 1926, pp. 392-397.

The rapid titrimetric determination of large quantities of manganese in technical iron alloys. T. Heczko. *Z. anal. Chem.*, No. 12, 1926, pp. 433-461 (in German).

The determination of gases in iron and steel. P. Klinger. *Stahl u. Eisen*, September 16, 1926, pp. 1245-1254 and September 23, 1926, pp. 1284-1288 (in German).

COPPER.—Further observations on copper and cuprous oxide. C. Blazey. *Metal Ind. (Lond.)*, September 17, 1926, pp. 261-263.

FURNACES.—The influence of oxidation reactions on blast furnace operation. F. Wüst. *Stahl u. Eisen*, September 9, 1926, pp. 1213-1221 (in German).

Pulverised fuel in metallurgical furnace practice. L. P. Sydney. *Metal Ind. (Lond.)*, September 3, 1926, pp. 215-220. A description of the Buell system and its applications.

GENERAL.—On the chemistry of metallic systems. A. Westgren and G. Phragmen. *Z. Metallkunde*, September, 1926, pp. 279-284 (in German).

Metallurgy fifty years ago and now. W. M. Corse. *J. Ind. Eng. Chem.*, September, 1926, pp. 892-895.

IRON AND STEEL.—The mill inspection of steel. C. McKnight. *Blast Furnace and Steel Plant*, September, 1926, pp. 376-382.

Bibliography of manganese steel. Part II. V. S. Polansky. *Blast Furnace and Steel Plant*, September, 1926, pp. 386-389.

Stainless iron. N. L. Mochel. *Trans. Amer. Soc. Steel Treating*, September, 1926, pp. 353-394. A discussion of the characteristics of low-carbon chromium-iron alloys.

Behaviour of carbon in a high chromium rustless iron. M. A. Grossmann. *Trans. Amer. Soc. Steel Treating*, September, 1926, pp. 436-446.

The influence of the temperature in the blast furnace on the properties of the pig iron. A. Wagner. *Stahl u. Eisen*, July 29, 1926, pp. 1005-1012 (in German).

The rational use of carburising materials. Practical results of systematic cementation experiments. Part II. J. Hébert. *La Technique Moderne*, September, 1926, pp. 525-532 (in French).

The theories of the tempering of steel. Part II. A. Sauveur. *Rev. Métallurgie*, August, 1926, pp. 446-462 (in French).

On electric steel melting. B. Egeberg. *Trans. Amer. Soc. Steel Treating*, September, 1926, pp. 395-408. Deals with the problems met with in making high-grade steels in the electric furnace.

The constitution of steel and cast iron. Parts III and IV. F. T. Sisco. *Trans. Amer. Soc. Steel Treating*, August, 1926, pp. 267-284 and September, 1926, pp. 457-475.

Commercial Intelligence

The following are taken from printed matter, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

ERVEDOSA TIN MINES, LTD., London, E.C.—Registered August 21, £50,000 debentures (secured by trust deed dated August 13, 1926), present issue £10,000; charged on properties at Ervedosa, Portugal, also general charge. *—, January 14, 1926.

HEATH (ROBERT) AND TOW MOOR, LTD., Stoke-on-Trent, coal and iron masters.—Registered August 23, £200,000 prior lien debentures (secured by trust deed dated August 5, 1926), present issue £84,500; charged on properties at Low Moor, etc., also general charge (in priority to charges created by trust deeds of May 31, 1888, and March 31, 1920, and supplemental deeds and £350,000 debenture dated August 23, 1923). *£1,166,878. June 11, 1925.

HENDY HEMATITE IRON ORE CO., LTD., Pontypridd.—Registered September 2, £500 debentures part of amount already registered; general charge. *£11,859. March 8, 1926.

LIGHTALLOYS, LTD., London, N.W.—Registered August 18, £30,000 (not ex.) debenture, to Vivian Younger and Bond, Ltd., 3, Abchurch Yard, E.C., metal merchants; general charge.

SHEEPBRIDGE COAL AND IRON CO., LTD., Chesterfield.—Registered September 4, £800 debentures, part of £750,000; general charge (except certain property). *£531,950. October 12, 1925.

Satisfaction

SHEFFIELD ALLOY STEEL CO., LTD. (late SHEFFIELD ALLOYS, LTD.).—Satisfaction registered September 10, £16,000, registered December 20, 1918.

The European Steel Combine

THE European steel combine has not yet come into being. Iron masters representing France, Germany, Belgium, and Luxemburg, met in Paris recently, but negotiations broke down, owing to difficulties with the Belgian delegates. The latter claimed a quota of 290,000 tons a month, and found themselves unable to agree with an offer of 265,000 tons plus priority rights on orders from year to year. British representatives were not present at the negotiations. The enormous importance which is attached by the Germans to the formation of this combine is shown by the fact that Dr. Stresemann, the German Foreign Minister, stated in Geneva (during the League of Nations meeting) that the Iron Pact about to be signed between France, Germany, Belgium, and Luxemburg was the biggest event in the recent economic history of Europe—a step towards the ending of frontier difficulties. It was, he added, intended that Great Britain should be a partner in this arrangement; but the British industrialists—for perfectly good reasons of their own—had thought fit not to participate. Perhaps they would come into it eventually.

"As this agreement has roused some fears and misgivings in Great Britain," Dr. Stresemann went on, "I want to state emphatically that it is not directed against any country. It cannot be, and it will not be, so directed. It has been rendered necessary by new and non-economic frontiers. A great iron ore region was taken from Germany and given to France, so that it was necessary to make an arrangement to rectify this as between France and Germany, as also as between two other countries closely involved—Belgium and the Grand Duchy of Luxemburg. Such economic agreements are the pace-makers for political agreements; and the Iron Pact is the first important step in an economic development to suppress frontier difficulties, to encourage international industrial co-operation, and to do away with unnecessary competition."



Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

The Metallurgy and Uses of Tin

By G. Malcolm Dyson, Ph.D., A.I.C.

In what follows Dr. Malcolm Dyson adds an article on tin to the numerous articles on other metals which he has previously published in the Metallurgical Section of THE CHEMICAL AGE.

SINCE tin is one of the easiest metals to separate from its ores it has been in use for a considerable time. It was indubitably known to the Romans, and there is but little doubt that it was in use at a much earlier period, since there is mention of a metal whose description corresponds with that of tin in an early Chinese manuscript. The use of tin is widespread, and both the pure metal and its many alloys find such extensive use in the arts, that it may be considered one of the most important of the non-ferrous metals.

Native tin is of comparatively rare occurrence, although it has been found in Guiana and Mexico together with metallic gold, while crystals of metallic tin have been found enclosed in certain specimens of Mexican bismuthite. Tin ores are not, however, very widely distributed, and large masses of tin-ore are uncommon. As exceptions may be mentioned the large veins of tinstone at Billitong and Banca, and those of some of the American deposits. The principal ore, tinstone, is usually found as water-worn nodules in the detritus of weathered crystalline and schistose rocks of the older geological periods, or disseminated as veins throughout the masses of these rocks. The general effects of the fact that tinstone exists as intrusive veins in the harder rocks, are that the ore is difficult to extract, and very impure when extracted, since not only is a very considerable amount of gangue inevitably mixed with the pure mineral, but it is a well-known fact that intrusive veins themselves are seldom pure, and that other minerals are bound to occur in the same vein and to be extracted along with the desired ore. Among the admixtures that frequently occur with tin ores, the tungsten ores are perhaps the most important, since not only do they provide one of the sources of that element, but in addition they have to be removed from the smelted ore if the finest quality and highest yield of tin is to be obtained. Other adventitious minerals occurring in tinstone veins are mica, topaz, pyrites containing much arsenic and copper, tourmaline apatite, etc.

Tinstone is the most important ore of tin, and consists mainly of tin oxide together with the impurities referred to above. The following analysis is the average of those obtained from a series of random samples of Bolivian tinstone. It may be remarked that the samples are of mineral, and not the mixed mineral and gangue, so that they represent, so to speak, the high-water mark of tin ore.

Tin oxide	78.350
Silica	8.430
Iron	5.684
Sulphur	1.680
Arsenic	1.450
Titanium dioxide	0.200
Copper	0.105
Tungstic acid	0.090
Nickel	0.047
Lead	0.034
Manganese	0.022
Bismuth	0.020
Zinc, antimony, silver	Traces
Water	3.888

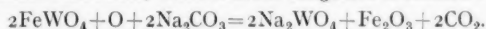
Of course, the impurities depend to a large extent on the nature of the surrounding mineral; and consequently the ores from various localities differ considerably. For instance, some of the American ores contain a fairly high percentage of titanium oxide, while those of Tasmania often contain a

considerable amount of bismuth and molybdenum. Apart from tinstone or cassiterite, there are but few minerals that contain tin, except in traces. Thus tin pyrites Cu_3SnS_4 , $(\text{Fe.Zn})_2\text{SnS}_4$ are occasionally found, and a few small deposits of the silicate have been located.

Washing and Magnetic Separation

The tinstone as it comes from the workings is mixed with a considerable amount of gangue, and very often only contains a few per cent. of tin. The consequence is that a long and costly mechanical enrichment has to be embarked upon before the actual smelting takes place. The two chief operations are washing and magnetic separation. The density of tin ore being high—6.5 to 7—washing is a very effective means of separating much of the siliceous gangue; but this process does not remove the iron or tungsten, the former of which is present mainly as the pyritic sulphide. A preliminary roast conducted slowly with the help of a rotary shaft calciner converts much of the sulphur into sulphur dioxide and volatilises any arsenic which may be present. This arsenic is condensed in very long flues and forms the source of most of the arsenic compounds of commerce. During the first part of the magnetic separation a weak magnetic field removes the bulk of the iron, leaving an ore containing 50 to 60 per cent. of tin and about 3 to 4 per cent. of iron. In some cases it is possible to separate the tungsten more or less completely by passing the purified ore through a strong magnetic field, thus giving in one operation a comparatively tungsten free ore and the tungsten concentrates, which form one of the commercial sources of this element. The ferrous sorting from the first magnetic separator still contains about 4 per cent. of tin, and further grinding and separation are used to recover this, leaving a final gangue, which contains only about 1 per cent. of tin.

The tungsten is not easy to separate completely either from the ore, or from the magnetic sortings obtained in the second magnetic operation, since it is itself in the form of an iron compound—ferrous tungstate. Where the amount of tungsten in the ores is fairly considerable, and is worth saving, an intermediate chemical stage for its extraction is interposed here. The reaction involved depends on the oxidation of the ferrous tungstate in the oxidising roast and in the presence of sodium carbonate, when sodium tungstate is formed:



The earlier method for this extraction was to roast the purified ore in a special furnace with sodium carbonate and in the presence of an oxidising draught. The melt was rabbled thoroughly and extracted with water. It has recently been found, however, that it is more economical and convenient to shovel the hot ore as it leaves the lower end of the rotary purifying calciner into hot caustic lye, when the tungsten is dissolved out. The lye is used until it contains about 10 per cent. of tungsten, when it is evaporated and sodium tungstate obtained.

Of the various methods which have been evolved for the winning of tin from its ores by smelting, there are two which have survived: reduction in the modified blast furnace, and reduction on the reverberatory furnace hearth, the latter being the process most commonly employed. The form

of blast furnace used for the tin reduction is quite primitive, and a typical example is shown in Fig. 1. The overall height of such a furnace is about 10 ft., and the working column height is 6 ft. The cross-section is usually square and of about 2½ ft. side, fitted with three tuyères fed from a rotary blower at the three lower sides. The fuel used is charcoal, which is mixed with an appropriate amount of ore and limestone and fed into the top of the furnace. The amount of charcoal is about 84 lb. to the cwt. of purified ore, and a yield of 70 to 75 lb. of tin to the cwt. is not unusual. This amount, however, includes the tin obtained by smelting the slags obtained, which often contain 12 to 15 per cent. of tin.

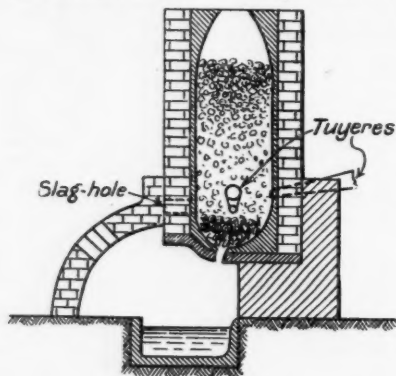


FIG. 1.

The more usual method is the reduction on the hearth of the reverberatory furnace. The furnace is of the usual type save that the hearth slopes from the back to the front and towards one side, in order that the tin may drain out into the heated well. The difficulties of the process lie in getting the furnace hot enough to effect complete reduction, and to "run" the metal together, without losing metal by volatilisation or by slagging it away as tin silicate. The exact proportions of the ore and anthracite dust (the reducing agent used), together with the slagging material, are matters of fine adjustment, and depend on the purity and nature of the ore. The ore ("black tin") as it comes from the various cleansing operations contains about 40 to 67 per cent. of tin, together with a varying amount of copper, lead, iron, and sulphur. The amount of sulphur in the ore determines, to some extent, the length of the heating period. Thus, for example, an ore which contains only a small amount of sulphur usually requires about one hour's heating per cwt. of charge, while an ore containing a fair proportion of sulphur will require about two and a half hours per cwt. This is due to the fact that the sulphur prevents the tin from "running," and the extra time that is required to drive off the last traces of sulphur makes the process fully twice as long. The amount of anthracite dust used is varied according to the amount of tin in the charge, and is calculated according to the following rule:

Percentage of tin.	Anthracite required in per cent. of the charge weight.
50-55	12
55-60	15
60-62	17.5
62-67	20

The amount of slagging material used in the melting is very important, since unless the precise amount required to slag off the gangue, etc., is used, there is danger of some of the tin being transferred to the slag as tin silicate. This always happens to some extent; but in order that the tin lost in this way shall be a minimum the theoretical amount of limestone is always added. To calculate the amount of limestone the charge of ore is assayed, and the amount of iron subtracted from the amount of silica present. This figure, plus 2 per cent. of the weight of the charge, gives the amount of limestone required. As an example, a charge was made up of the following three batches of ore:

22 cwt. of ore assaying 61.5 per cent. Sn, 4.0 per cent. Fe, 16.1 per cent. SiO₂.
 16 cwt. of ore assaying 65 per cent. Sn, 3.8 per cent. Fe, 12.0 per cent. SiO₂.

22 cwt. of ore assaying 58.5 per cent. Sn, 4.2 per cent. Fe, 22.0 per cent. SiO₂.

The amounts of iron and silica are calculated:

22 cwt. with 4.0 per cent. Fe = 0.88 cwt. Fe.
 22 cwt. with 16.1 per cent. SiO₂ = 3.542 cwt. SiO₂
 16 cwt. with 3.8 per cent. Fe = 0.608 cwt. Fe.
 16 cwt. with 12 per cent. SiO₂ = 1.92 cwt. SiO₂
 22 cwt. with 4.2 per cent. Fe = 0.924 cwt. Fe.
 22 cwt. with 22 per cent. SiO₂ = 4.84 cwt. SiO₂

2.412 cwt. 10.302 cwt.

The difference between these two weights—7.89 cwt. plus 2 per cent. of the weight of the charge—1.2 cwt.—gives 9.09 cwt., which is the weight of limestone which is added. In practice a little fluorspar is also added to make the flux run well.

The anthracite charge for the above batch is worked out thus:—

22 cwt. of ore with 63.5 per cent. tin (Calc. at 17½ per cent.) 3.85 cwt.
 16 cwt. of ore with 65 per cent. tin (Calc. at 20 per cent.) 3.2 cwt.
 22 cwt. of ore with 58.5 per cent. tin (Calc. at 15 per cent.) 3.3 cwt.

Total anthracite dust 10.35 cwt.

The charge will therefore contain 3 tons of mixed ore, 10.35 cwt. of anthracite dust, and 9.09 cwt. of limestone slag. The thoroughly mixed charge is wetted and thrown on to the floor of the already heated furnace, and the dampers opened in order that thorough heating may take place. Later the dampers are closed somewhat, so that the reducing atmosphere of the furnace shall be maintained. The actual control of the furnace during the reduction is, of course, a matter of very considerable experience and its minutiae do not concern us here. Care has to be taken that the temperature of the furnace does not become too high, or else part of the tin will be lost by volatilisation, whilst if the temperature is insufficient the reduced tin will not run together, and an excessive quantity will remain behind in the slag. It must be borne in mind that the tin obtained in this first smelting operation is only about two-thirds of that contained in the ore, and that a considerable portion always remains behind in the slag, both as metallic inclusions and chemically as tin silicate. This fact necessitates several resmeltings of the slag in order to obtain its tin. In the first operation the slag remaining after the separation of the tin is known as "rich" slag and is smelted with anthracite and iron borings or scrap, together with the dross from the liquation house. Such a slag may contain as much as 30-40 per cent. of tin, and in one furnace in which the slag used was a mixture of bauxite and limestone, the "rich" slag analysed out at:—

Tin	35 per cent.
SiO ₂	15 "
Al ₂ O ₃	22 "
Iron	9 "
Lime	18 "
Ti, Mg, Mn, etc.	0.5 "

The interaction of the tin silicate and the metallic iron to give tin and ferrous silicate is the chemical basis of tin slag smelting, and tin obtained contains about 95 per cent. of the metal, the remainder being iron, which gives the alloy a grey colour and renders it brittle. The "poor" slag from this operation still contains enough tin to make it worth the cost of resmelting, and usually contains about 2½ per cent. of tin as the silicate and 10 per cent. as inclusions. The "poor" slag is smelted with coal and anthracite and during the operation is well rabbled on the hearth of the furnace, since the tin only collects slowly. The tin-iron alloy obtained in the smelting contains about 10.5 per cent. of the latter metal, and is very dark and brittle.

Numerous patents have been taken out for alternative methods of smelting or chemically extracting tin from its ores. Methods have been proposed for extracting the metal by acid or caustic solution of the tin oxide from the ores followed by evaporation and smelting of the residue, or by electrolysis of the solution so obtained. These methods have not, so far, met with any wide measure of success. Other furnaces and methods which are established features of American practice in tin smelting, employ a giant blast flame, fed with compressed air and heavy oil. This flame plays

upon the mixed ore and anthracite in the same way as the flame and gases of a reverberatory furnace, but has the additional advantages of being easily controlled, both with regard to heating and reducing properties, and of giving a more rapid rate of heating than the older type. This process is being used in Texas, among other places, by the American Smelting and Refining Company, and is found especially satisfactory for the treatment of the Bolivian ores which contain a very high percentage (65-67) of tin.

Proposals have also been made for the electrical smelting of tin ore, but they are scarcely yet of much importance. More valuable are the several processes which have been devised from time to time for the extraction of the tin from the enormous amount of tinplate scrap, which accumulates in the canning, etc., industries. The scrap is treated either by chlorine or by electrolysis. In the first of these processes the partially compressed tinplate scrap is treated with chlorine at 40°-50° C., when the tin is converted to the liquid chloride. This is not as a rule worked up into tin but into the various tin derivatives which find extensive use in the textile industries. In one ingenious plant for the recovery of tin from tinplate scrap, the scrap is heated to about 240° C. in a centrifuge rotating at high speed, when the molten tin is flung outwards and can be collected as the metal.

Purification

Liquation or "sweating" is the standard practice for the preparation of pure tin from the smelted metal. The principle of the operation, of which there are innumerable practical variations, lies in the fact that if a bar of impure tin is gradually heated, the tin melts out first and leaves a residue of higher melting alloys. The success of this operation in practice depends on getting the rise of temperature as even as possible, and on never at any time exceeding the melting point of pure tin. In modern works the temperature of the liquation bed is watched by means of electrical pyrometers. Further purification of the tin is conducted by "poling" as with copper, or by electrolysis when very pure tin is required.

The impurities in tin are of vital importance, and regulate the selling price. Thus, in printers' alloys, the presence of a small amount of copper or zinc is fatal, since it renders the alloy totally unfit for use in the various automatic typesetting machines, and even in solders the presence of one part of copper in two thousand leads to difficulties in the operation of automatic soldering plant. The "pure tin" of commerce maintains a very high standard of purity. Thus, the average tin content of seven different brands was 99.917 parts per hundred, and quite recently a pure tin ("Chempu Brand") has been put on the market containing 99.985 per cent. of tin; its impurities analyse out as:—

Antimony	0.0055
Lead	0.0030
Iron	0.0020
Copper	0.0005
Bismuth	0.0005
Arsenic, zinc, magnesium, gold, silver and sulphur	Nil

This form of tin is very soft and has very little tensile strength, breaking at about 0.88 ton/sq. in., and showing an 86.5 per cent. elongation in a 2½ in. test piece.

Ordinary tin is harder and tougher than this by virtue of its impurities, and the variety occasionally met with containing 93-96 per cent. of tin, 1.3-3.5 per cent. antimony and 0.5-1.2 per cent. of copper is quite hard and has considerable strength. The old test, in which a bar of tin was bent and the "cry" listened for, is no real criterion of purity since the presence of antimony or a trace of copper does not prevent the production of this sound, which is due to the mechanical rubbing of the crystals. For judging the rough grades of tin the inspection of a highly polished surface is one of the best tests, the character and number of the "spots" indicate the nature and extent of the impurities. It fails, however, to detect traces of impurities, for which the real test is, of course, an analysis. It is well to bear in mind that the purpose for which tin is to be used is the real deciding factor as to whether an impurity is a really serious objection. Thus, tin for bronze need not be copper-free, nor tin for type metal free from antimony.

Tin itself is a bright white metal melting at 232° C. and boiling about 1500°-1600° C. It is a comparatively soft

metal, its hardness lying between those of lead and gold. It exists at ordinary temperatures in the unstable condition, the normal form being only stable below the transition point, 18° C. "Grey" tin is obtained as a coarse, dark grey, granular powder of no mechanical strength when white tin is submitted to a very low temperature, and its formation need only be feared in practice when particularly severe and prolonged frosts are experienced. Tin is very little attacked by dry or moist air, although in the presence of the latter it becomes covered with a white film. The analysis of a crust of corrosion material from a pure (99.98 per cent.) tin scabbard found at the foot of Caradoc (probably Roman) gave:—

Tin	76.82
Water	5.10
Copper oxide	0.81
Sulphur trioxide	0.85
Iron oxide	0.12
Lime	0.10

This seems to show that the corrosion proceeds with the formation of hydrated stannous oxide, which is later dehydrated and oxidised to stannous oxide.

Apart from its alloys, which are many and important, the bulk of tin is used for the manufacture of tin plate—a matter of considerable technical intricacy. The value of tin coated sheets and utensils lies, of course, in the absence of any tendency for the outer film of tin to be corroded by the acid juices of foodstuffs.

Canadian Nickel and Copper in 1925

FINALLY revised statistics on the output of copper in Canada, as reported by the Mining, Metallurgical, and Chemical Branch of the Dominion Bureau of Statistics at Ottawa, show a production in 1925 of 111,450,518 lb., which at the average New York price for the year (14.042 cents per lb.) amounted to \$15,649,882 as compared with 104,457,447 lb. valued at \$13,604,538 in 1924, when the average New York price per lb. was 13.024 cents. This was an increase of 6.7 per cent. in quantity and 15 per cent. in value. Copper is produced in Canada in the Provinces of British Columbia, Ontario, and Quebec. British Columbia accounted for slightly less than two-thirds of the total Canadian output and Ontario a little more than one-third. Quebec produced a small amount. Large deposits are known to occur in Northwestern Manitoba and in the Rouyn district of Quebec. These areas are being developed at present, and when the production stage is reached the output of copper from these two provinces will probably contribute largely to Canada's total production. The total output included: (a) 39,272,989 lb. contained in nickel-copper matte produced at Sudbury, part of which was exported and part refined in Canada; (b) 33,259,609 lb. of blister copper, a small part of which was refined at Trail, B.C., the remainder being exported to the United States for refining; (c) 30,342 lb. contained in copper sulphate; (d) 38,887,578 lb., the estimated recoveries from ores, concentrates and residues exported for treatment. The corresponding figures for 1924 were (a) copper in matte 36,979,424 lb.; (b) blister copper 35,109,895 lb.; (c) copper in copper sulphate 31,825 lb.; and (d) copper contents of exported material 32,336,303 lb.

The Canadian output of nickel during 1925 was 73,857,114 lb., valued at \$15,946,672, as compared with 61,356,451 lb., worth \$12,126,739 in 1924. These figures for 1925 include nickel in matte exported by the Mond Nickel Co. and the International Nickel Co. of Canada at 18 cents a lb.; refined and electrolytic nickel produced at Port Colborne, at the value obtained for such products sold during the year; nickel in nickel oxide sold from the South Ontario smelters and from Port Colborne at its total selling value as oxide; nickel metal sold from South Ontario smelters; and nickel contained in speiss residues exported, valued at 18 cents a lb. The detailed figures are as follows: (a) nickel in matte and speiss exported, 1925, 32,787,846 lb., valued at \$5,901,812; and 1924, 26,374,882 lb., valued at \$5,747,479; (b) refined and electrolytic nickel produced, 1925, 31,976,310 lb., valued at \$7,315,701, and 1924, 25,448,882 lb., valued at \$5,313,587; and (c) nickel in oxides and salts sold, 1925, 9,092,958 lb., valued at \$2,729,159, and 1924, 9,532,687 lb., valued at \$2,065,673.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Streatfeild Memorial Lecture

THE ninth annual Streatfeild Memorial Lecture will be delivered by Mr. F. C. Robinson at the Institute of Chemistry, 30, Russell Square, London, W.C.1, on Friday, November 19, 1926, at 8 p.m.; subject, "The Chemist in the Non-Ferrous Metallurgical Refinery"; Professor G. G. Henderson, D.Sc., F.R.S., President of the Institute, in the chair. The lecture is open to all fellows, associates and registered students. Tickets of admission (gratis) are obtainable by other persons on application to the Registrar, Institute of Chemistry, 30, Russell Square, London, W.C.1.

The Multiplication of Societies

THE multiplication of societies and institutions is nearly always to be deprecated. The latest suggestion is to establish an American "Chapter" of the Society of Steel Treathers in this country. The argument seems to be that if the older institutions neglect a branch of technology of such admitted importance some new association should fill the breach. The question is of wider interest to metallurgists generally than the title of the proposed "Chapter" would imply, seeing that the American Steel Treathers' Society by no means confines its attention to steel, but also deals with the non-ferrous metals, the scientific heat-treatment of which is equally important. The proposal has not met with much support; an earlier proposal of the same kind some years ago shared the same fate. That very practical body, the Sheffield Trades Technical Society, devotes a good deal of attention to questions of heat treatment, and other institutes and local societies devote, spasmodically, some time to them. In the meantime, the tendency is rather for the older societies to join forces than to encourage the formation of new associations. The experiment now being made by several such bodies in Birmingham and South Staffordshire, will be viewed with sympathetic interest. Here the Staffordshire Iron and Steel Institute, the Birmingham Metallurgical Society, and the Birmingham Local Section of the Institute of Metals have formed a co-ordinating committee, and arranged for a series of joint meetings open to the members of each of the constituent bodies. It is undoubtedly a step in the right direction.

Fuel and Electroplating

MEANWHILE, two examples of the opposite tendency may be cited. Fuel technology had, until recently, no niche of its own, but was the Cinderella of a number of older bodies who displayed very little interest or sympathy with their youngest sister science. Now there are two institutions devoted to fuel research. It is felt by many that this is unnecessary. The President of the Institution of Fuel Economy and the President of the Institution of Fuel Economy Engineers are one and the same, and the Honorary Secretary of the former is a member of council of the latter. The other example of the formation of a new body is one for which there is, however, every justification, namely, the Electroplaters' and Depositors' Technical Society. This body is new in the sense that it has only been in existence for about a year, and is holding its first annual general meeting on November 10. It is a very live group, as those who have attended its meetings hitherto can attest. It has affiliations with that excellent association, the Faraday Society, and during the forthcoming session, for which a splendid programme of papers has been arranged, it will hold one of its meetings, most fittingly, in Birmingham. It owes much of the success it has achieved to the energy and devotion of its President, Mr. S. Field, of the Northampton Polytechnic Institute, and to the enthusiasm and driving force of its Honorary Secretary, Mr. W. E. Harris. It is safe to prophesy that the Electroplaters' and Depositors' Technical Society will have a useful and vigorous future.

An Engineering Misconception

A VERY curious remark was made by one of the members of the Royal Aeronautical Society, on the occasion of the reading of a paper on October 21, by Mr. W. R. D. Jones, on "Magnesium and Its Alloys." Mr. Jones, in his opening remark, had noted—as who has not?—the extraordinary

development which has taken place in regard to the production of commercially pure metals. Apparently one member, at least, amongst his audience was not aware of this development and what it imports. The remark was to the effect that engineers do not use pure metals, and the implication was that such metals are of no use. In view of the fact that all the commercial metals have, for some years past, been obtainable in bulk, and have innumerable applications, the remark seems to indicate that however greatly metallurgists themselves are concerned with this ultra-important modern development, there are still some engineers who do not appreciate the facts involved. Purity is, of course, a relative term. Chemical purity is not, perhaps, attainable. The commercial purity of practically all the commercially pure industrial metals is, however, so great as to be hardly distinguishable from chemical purity. Indeed, it may be said that the physical and chemical properties of metals are only constant in proportion as their composition approaches ideal purity. The faintest trace of any impurity modifies, for better or worse, nearly all the properties, often to an unknown degree. The constants of a pure metal *are* constants; in impure metals, they may or may not be, for the impurities introduce perturbations the consequences of which it is not always possible to foretell. This, in engineering, is a factor of prime importance.

Magnesium and Its Applications

MR. JONES' paper is the most important contribution to the subject of magnesium in engineering that has yet been published in this country. It is gratifying to recall that practically the first serious article on magnesium, summarising the scattered information then available, and adding thereto the latest particulars, appeared in the columns of THE CHEMICAL AGE nearly a year ago (November 7, 1925, pp. 33-34). Mr. Jones quotes this and other sources of information, and adds a great deal of important detail derived from his own researches and information. He predicts that magnesium will soon be "a serious rival to aluminium, not only in properties, but also in price." In six years, the price has fallen from 22s. 6d. per pound to 3s. 5d. per pound, or less than one-sixth. This cheapening of the metal is a very significant fact, although it falls very far short of the drop, unparalleled in the history of metals, which took place within a similar period of time (1852-1858), when the price of aluminium fell from \$545 per pound to \$11.33 per pound, or even the sustained depreciation of 1886-1892, when it fell from nearly \$8 to a little over half a dollar. In the case of aluminium the demand had to be created; in the case of magnesium it already exists—if not here, then in France, in Germany, and in the United States. There is no intrinsic reason why magnesium should not become as cheap as, or cheaper than, the older metal.

The Sorby Lecture

THE Fourth Sorby Memorial lecture delivered by Professor H. C. H. Carpenter, F.R.S., at Sheffield, on October 22, deals in a particularly lucid way with a very fascinating subject. We owe to the researches of Professor Carpenter and Miss Elam much of what is known as to the production of large single crystals of metals. Their pioneer work in this investigation was with aluminium. Professor Edwards followed it up with the production of large single crystals of iron. Dr. Smithells, who has recently written a book on the subject, has built up large single crystals of titanium. The Sorby lecture describes, *inter alia*, the production of pure zirconium. Here again, the extraordinary influence of the elimination of impurities displays itself. Hitherto, zirconium prepared by chemical methods from the chloride has been found to be hard and brittle. Built up by deposition on a glowing metal filament, by the thermal dissociation of a volatile compound, the metal is ductile, and can be cold-hammered and rolled. The great enemy of pure metals is oxygen. Grown in an atmosphere of nitrogen, single crystals of gold, silver, and copper have been produced quite free from blow-holes. When melting is carried out *in vacuo*, there is a liability for blow-holes to be formed, although the source is not always dis-

coverable. From single crystals there is an almost limitless amount of new and fundamental knowledge to be derived, as to the inherent and specific properties of metals, lattice structure, and general behaviour. Metallurgists will be grateful to Dr. Carpenter for the work already done and will anxiously await further details.

Hardness

WHAT is hardness? If we knew the cause of hardness we should be the better equipped for controlling its degree, which at present is still more or less an empirical operation. We have, moreover, to decide, to begin with, what is meant by hardness, or which of the various kinds of hardness we are specially seeking to elucidate. Does, say, cutting hardness—the kind sought in machine tools—result from some special configuration of lattice structure, and if so, from what precise configuration? Is the cause of the hardness of the diamond similar in kind to that of an aged magnesium alloy, or a quenched "martensitic" steel? Metallurgists have been at work on this problem of so many indeterminates for decades, and have evermore come out by the same door wherein they went. Professor Albert Sauveur has been sending out questionnaires to various distinguished metallurgists on the subject, and on the allied question of the nature of martensite, the hard structure of steel. One of the questions—"Why is martensite hard?"—has been answered in much the same spirit as Pontius Pilate might himself, had he waited long enough, have answered his own historic inquiry. Thus Chevenard and Portevin reply, "one might just as well ask why the diamond is much harder than graphite." This reply obviously misses the point.

Various Views on Martensite

SIR ROBERT HADFIELD's answer is that of a philosopher. He says there are insufficient data available to establish definitely the reason. Most of the other replies suggest that martensite is an iron carbide either in solid solution or evenly suspended, or partly the one and partly the other, in alpha iron. A few think gamma iron is the mother medium. It is easy to conceive that the intrusion of a foreign body into a lattice might stiffen the latter, but it is plainly the rôle of X-ray analysis to decide if this is really the explanation. Is the crystal structure alone modified? Is the process molecular—molecular action has been a good deal ignored of late—or is the atomic structure itself involved? The answers Professor Sauveur has received are for the most part inconclusive. We still do not know the true cause of hardness; we know its effects only.

Properties of Ternary Alloys

IN the study and development of ternary alloys great importance would attach to any systematic procedure of work, since many have come into being by the "hit or miss" process. An attempt to determine how far a systematic procedure might be devised in any given case, and what, if any, fundamental principles could be found which might be of assistance in the development of an alloy having industrial value, is presented in a paper by Lyman J. Wood and S. W. Parr, entitled "Correlation of Physical and Chemical Properties in Alloys of the Ternary Type," read before the American Institute of Chemical Engineers, and published as a Ph.D. thesis submitted to the University of Illinois. A working hypothesis was set up to the effect that the alloys of a ternary system possessing greatest resistance to corrosion would at the same time possess the greatest tensile strength. This hypothesis was tested out in a number of cases, such as the systems copper-zinc-tin, copper-zinc-nickel, and copper-nickel-aluminium. In the latter case the effect of adding a small quantity of a fourth component was examined.

Results of Above Investigation

An alloy of three components of any possible combination of those constituents can be located upon a triangular or three-place diagram. The number of such possible combinations is infinite. In the alloys studied in the above investigation certain principles appear to have been established, as follows:

I. That in any three-component system the combinations producing alloys having physical properties which give them industrial value are located within a relatively narrow or restricted area within the diagram.

II. In any three-component system those combinations which have the greatest tensile strength are, for that system, the combinations most resistant to corrosion.

III. The microscopic examination of these maximum alloys shows them to be made up of one kind of solid solution.

IV. The cooling curves of these maximum alloys do not show any sharp breaks but are smooth, thus indicating the presence of a solid solution.

V. Both the tensile strength and resistance to corrosion by acids are dependent upon an influence which is an inherent property of the metal and which is in turn dependent upon the composition of the alloy.

VI. Any influence that makes easier the formation of solid solutions improves the tensile strength and corrosion-resisting properties of a ternary alloy.

VII. Subsidiary elements added to a ternary alloy may increase the valuable properties or tend to destroy them, depending upon whether solid solubility is helped or hindered.

Spain and Steel Imports

ROUSED by the Spanish Government's attack on her special steel imports into that country, Sheffield manufacturers are inaugurating a national campaign urging the denouncing of the new Spanish commercial treaty. The assistance of all Chambers of Commerce throughout the country has been sought, and active propaganda work has been undertaken. A deputation recently waited on the President of the Board of Trade in order to urge the importance of Government action in the matter.

Members of the trade feel that they are being unfairly treated, especially in view of the fact that this country is one of the best markets for Spanish wines, oranges, almonds, and other products. Frequently the Sheffield Chamber of Commerce receives applications from Spanish wine growers for the names of wine merchants in the district, but at present these applications are not being acceded to. The President of the Chamber, replying to one received a short time ago, said: "In view of the Spanish Royal Decree, which hinders and practically prohibits the importation of Sheffield steels into Spain, we are determined not to buy the products of your country until the said decree has been cancelled. . . . A rigorous and intensive propaganda is about to be initiated in the Press so that the public here may abstain from buying the wines, almonds, oranges, etc., of Spain, until this decree has been modified, which is directed against a country which constitutes one of the best markets of the products of Spain."

American Iron Industry in 1925

CONSIDERABLY more iron ore, pig iron, and ferroalloys were produced and shipped in the United States in 1925 than in 1924, according to figures compiled in the Bureau of Mines, and just made public by the Department of Commerce. The iron ore mined in 1925 amounted to 61,907,997 gross tons, an increase of 14 per cent. as compared with 1924. The shipments of iron ore in 1925 amounted to 63,924,763 gross tons, valued at \$161,796,886, an increase in quantity of 23 per cent. and in value of 6 per cent. as compared with 1924. The average value per ton of iron ore at the mines in 1925 was \$2.52, which is 39 cents less than in 1924. The stocks of iron ore at the mines at the end of 1925 amounted to 10,795,630 gross tons, compared with 12,410,619 tons at the end of 1924, a decrease of 13 per cent.

The shipments of pig iron from blast furnaces in 1925, amounting to 36,814,702 gross tons, valued at \$739,316,333, showed an increase of 19 per cent. in quantity and 11 per cent. in total value. The general average value of pig iron of all grades at the furnaces in 1925 was \$20.08, a decrease of \$1.33 from the value in 1924. The production of pig iron in 1925, exclusive of ferroalloys, was 36,124,678 gross tons, compared with 30,869,199 tons in 1924. In the production of pig iron in 1925 there were used 62,029,734 gross tons of domestic iron ore and manganiferous iron ore; 2,337,767 tons of foreign iron ore and manganiferous iron ore; and 5,137,068 tons of cinder, scale, and scrap, a total of 69,504,569 tons. An average of 1924 gross tons of metalliferous materials was consumed per ton of pig iron made in 1925, as compared with 1896 tons in 1924.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

ALTHOUGH there is still no settlement of the coal dispute, and consequently no resumption of operations in the steel works, the past month has not been without interest to the steel trade.

The Continental Steel Pact

Reference has been made previously to the steel pact that has been arranged by Germany, France, Belgium, and Luxembourg. This pact is now definitely in being, and it has been made a matter of more immediate interest to the steel trade of Great Britain by the recent Anglo-German conference at Romsey. Although the conference was not expressly designed to deal with this one question, there is no doubt that the possible entry of Great Britain into the pact was one of the main points discussed. It is significant that among the delegates from this country were Sir Robert Horne, Mr. H. Bond, the President of the National Federation of Iron and Steel Manufacturers, and Sir William Larke, Director of the Federation. In fact, it is no longer a secret that as an outcome of that conference the steel manufacturers of this country as a whole are carefully considering the proposal. It will be remembered that in his recent speech at the annual meeting of United Steels, Ltd., the chairman of that great combine made reference to this matter and showed by his words that he is inclined to favour the entry of Great Britain into the European cartel.

Conditions to be Faced

Naturally the proposal requires very serious and careful consideration before a decision is reached. The object of the cartel is said to be the limitation of production and the restriction of competition in foreign markets. No one will deny that these are just now very laudable objects. There is an actual excess of production capacity over the requirements, ignoring, of course, the abnormal conditions created by the coal strike, and although optimists tell us that in the near future the consumption of steel will grow rapidly and quickly overtake the production, we must realise that over-production is a definite fact, and is likely to remain so for some time to come. The results of it are seen in intensified competition, price cutting, high costs of manufacture owing to the partial employment of the works, and in general a condition of affairs which is very unsatisfactory not only for the individual works but for the trade as a whole.

The competition which has arisen out of this condition, assisted as it has been by the depreciation of the exchanges, has reached a degree of intensity equal to, if not surpassing, that of any previous period in the history of the industry. The prices at which work for export has been taken have been cut lower and lower until manufacturers have been faced with one of two alternatives, both of which, if unchecked, must end in disaster: either to shut up the works with the heavy loss which such a step involves, or to carry on at the low prices ruling and pile up losses that way.

Objects of the Cartel

The cartel seeks to prevent these conditions by taking as a basis the average annual production of the countries joining in the scheme, and then fixing a quota for each country, the quota representing the tonnage which each country shall be allowed to produce. For the five European members of the cartel the approximate percentage of the total output are allocated as under:—

Germany	41 to 43 per cent.
France	31 to 32 per cent.
Belgium	12 per cent.
Luxembourg	8 per cent.
Saar	6 per cent.

The above figures are approximate and they vary according to the total annual production. The tonnage to be allotted to each country is decided quarterly. The production includes steel made by the Thomas, Bessemer, Siemens Martin crucible and electric processes. For every ton which a country produces up to the amount of its quota the sum of one dollar per ton is paid into the common fund. If the production exceeds the quota then the payment is increased to 4 dollars per ton. The amount of the fine is intended to be sufficient

to prevent any country exceeding its quota to any great extent. If the quarterly production falls below the quota, then the country concerned receives a payment from the fund of 2 dollars per ton for each ton short of the quota, up to a maximum of 10 per cent. of the quota. This compensation payment is subject to certain conditions.

Continental and British Conditions

The Governments of the respective countries have given their consent to the cartel, but it is to be noted that the agreement and co-operation of the steel manufacturers is the essential part. In Germany one does not expect much difficulty in securing that. The people are used to being organised and disciplined, and anything in the nature of a trust or combination or whatever it may be called which seeks to discipline the industry and organise it into an efficient unit is likely to meet with success. In France and Belgium the same applies, although not to the same extent. In Germany practically all the steel works have been organised into five big groups, and this further facilitated the formation of the cartel. Conditions were not quite so favourable in France and Belgium, and it took quite a long time to get their agreement to the arrangement; and even now Belgium's participation is by no means firmly established.

These points are mentioned because they help in arriving at a decision as to the advisability of Great Britain's entry into the scheme. The conditions here are somewhat different. We have several instances of large combines which comprise a number of individual plants, but we have nothing like the group system in Germany, consequently there is no central body which can speak with authority for the industry as a whole or for the different geographical sections. The National Federation of Iron and Steel Manufacturers includes practically the whole of the steel makers in the Kingdom, but while it watches over the general interests of the industry, each firm is left at liberty to create its own policy and carry on its operations in the manner which it deems best.

The Chief Obstacle

In this individual character of the steel makers of this country lies the chief obstacle to participation in the European steel pact. England's greatness as a commercial nation has been built up on the foundation of this characteristic individual energy and enterprise, and it is going to be very difficult to induce the various manufacturers to sink that individuality and become merged into one organisation which will in a measure control the policy of all the works, and will have in fact the power to decide which works shall carry on and which shall close. It is true that there are a number of works which are out of date, and they seem to take a long time in succumbing to the usual fate of inefficiency. On the other hand, there are a lot of works which have been kept in a high state of efficiency and which are in a position to make full use of any opportunity for trade, and these are not likely to yield easily to any scheme which will allot them only a portion of the orders which they are seeking to obtain. On the whole it is doubtful whether England would benefit at all by joining the cartel, but it is certain that the proposal is being seriously considered, and by the end of the month it may be possible to say more definitely what is likely to be done.

Coal

Meanwhile the coal strike drags wearily along. The collapse of the strike by the return of the men is not being realised, as the rate of return is too small to have full effect. Prominent leaders in the coal industry take a rather pessimistic view of the situation and seem to expect the stoppage to continue for several weeks yet. The recent developments have aroused an expectation of an early settlement, but the grounds for a settlement are not evident. The miners still insist on no increase of hours, and the owners are adamant in their demand for at least a seven and a half hour day if not eight hours. No matter what happens now, it can be taken that no steel will be produced this year. When the collieries do start, it will take a week or two to get supplies of coke through the ovens and by the time pig iron is being produced in normal quantities and fuel supplies are coming through regularly we shall have seen the turn of the year.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Lead and Zinc

ACCORDING to a patent application by the Krupp Grusonwerke Akt.-Ges., Magdeburg, Germany, lead and zinc can be separated from ores or other products containing both by first roasting the materials under oxidising conditions so as to volatilise the lead as oxide or sulphate, and then roasting the residue with addition of a reducing agent to volatilise the zinc as metal. Antimony, or other volatilisable metal, passes over with the zinc. See Patent application 256,601, having the International Convention date, August 8, 1925.

Tin

IN a further patent application the Krupp Grusonwerke Akt.-Ges. describe also the separation of tin from materials containing it by volatilisation as sulphide. This is effected by heating the materials in a reverberatory furnace or blast furnace, if necessary with addition of a solid sulphur-containing compound such as pyrites. Fuel or other reducing agent may be added to prevent oxidation when the former furnace is used. See Patent application 256,634, having the International Convention date, August 7, 1925.

Gallium, Indium, etc.

THE British Thomson-Houston Co., Ltd., London, describe a process for removing oxide impurities from gallium, gallium alloys, or related metals such as indium. The metal is treated with hydrochloric acid, or a dry halogen, to convert the oxide film into chloride. The metal is then heated to 500° C. *in vacuo* to volatilise the chloride and finally to 1000° C. to remove hydrogen and other gases. See Patent application 256,950, having the International Convention date, August 12, 1925.

Alloys

AN alloy consisting substantially of aluminium 84 per cent., tin 10 per cent., and zinc 6 per cent., specially suited for the production of the print rollers or blocks used in the printing of wallpaper is described in Patent No. 258,490 (J. Walrath, New York State, U.S.A.), having the date, March 15, 1926.

W. Denecke, of Heidelberg, Germany, describes copper-silicon alloys suitable for use as constructional materials in the form of castings, etc. They contain 5 to 10 per cent. of silicon and 1.5 to 12 per cent. of nickel, iron, or cobalt; small amounts of chromium, tungsten, molybdenum, titanium, or vanadium may also be present; while an addition of up to 1 per cent. of arsenic increases the resistance of the alloys to acids and renders them suitable for use in chemical apparatus. See Patent No. 259,091, having the date, February 2, 1926.

Silver alloys containing 30 to 70 per cent. of silver, said to resist the usual chemical agents at least as well as richer alloys are described by the Soc. Française de Monayage, Paris, France. The other components of the alloys are nickel, copper, and zinc. Instructions are given for the preparation of alloys containing 40 and 50 per cent. of silver respectively. See Patent No. 259,108, having the International Convention date, February 2, 1926.

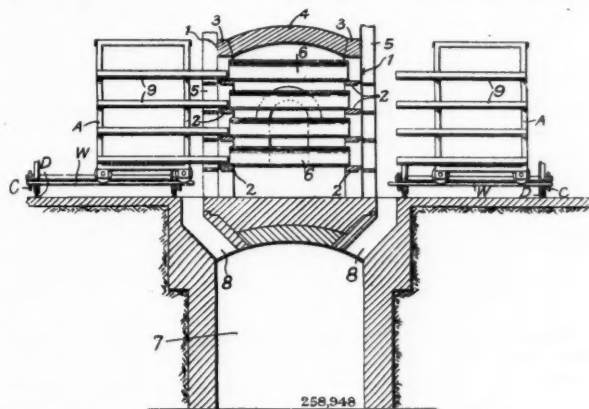
Flotation Processes

WHEN certain ores, particularly certain gold and platinum bearing minerals, are subjected to froth-flotation, substantial quantities of gangue often tend to float. It is now found that this tendency may be reduced by adding an organic protective colloid in regulated amount to the pulp of ore and flotation-agent. Too much protective colloid must not be added or the flotation of all the constituents of the ore may be inhibited. An addition of an alkali xanthate is also sometimes beneficial. The treatment of a Norite sulphide ore from the Lydenburg district, containing 0.21 per cent. of nickel, 0.11 per cent. of copper, and 2.1 dwts. per ton of platinum metals is described. The powdered ore is subjected to a preliminary flotation with cresol and sodium xanthate, the concentrate (about one-fifth of the crude ore) diluted and again subjected to flotation after addition of starch. The final concentrate contains 7.68 per cent. of nickel, 3.75 per cent. of copper, and 73.7 dwts. per ton of platinum metals, 89 per cent. of the latter being recovered. Glue and gelatine can be used instead of starch.

See Patent No. 258,648 (Minerals Separation, Ltd., and J. C. Moulden, London), having the date, June 22, 1925.

Distillation Furnaces

E. M. JOHNSON, of Oklahoma, U.S.A., describes a furnace for the extraction of volatile metals from their ores. It consists of a battery of double-ended retorts 6 mounted in a heating chamber, condensers being luted on to the ends in the usual way. At the ends of the retorts are provided carriages



A, A, carrying trays 9 into which the materials of the charge have been previously loaded. After bringing the carriages opposite the retorts to be charged, the trays are pushed forward, and the charges transferred to the retorts. When distillation has been effected the residues are pushed out of the retorts and fall through the chute 8 into the cellar 7.

Electro-deposition of Chromium

Two new methods are described for the electro-deposition of chromium. According to the first a chromic acid bath is employed, with addition of a small amount (not exceeding 3 per cent.) of copper, or less advantageously nickel or zinc. Smooth thick deposits free from laminations or cracks are obtained, the small amount of added metal not being precipitated from the bath. See Patent No. 258,724 (C. L. Long, D. J. Macnaughten, and G. E. Gardam), having the date, September 4, 1925.

In the second process a bath containing chromic acid or chromates and a small amount of sodium sulphate is used in conjunction with anodes of dense lead such as rolled lead but not cast lead. The bath is preferably slightly acid and the deposition is effected at 35-40° C.; firm deposits can be produced even upon aluminium or cast iron. See Patent No. 259,118 (R. Appel, Berlin), having the International Convention date, November 26, 1925.

Steel Prices

DURING October the steel manufacturers have decided to increase the prices of steel a further 5s. per ton, which makes 10s. advance on the pre-strike prices. The prices being actually quoted are somewhat higher than the advance indicates, but there is some confusion owing to the fact that high prices are being paid for any material which is now available. The inquiries that are being sent out do not amount to any great weight, as most consumers realise that makers are not willing to enter into forward contracts owing to the uncertainty of the trend of prices for fuel and raw materials when the coal strike is ended. There is still a limited quantity of foundry pig iron in stock in the North, and the prices obtained for it are exceptionally high, as much as £6 15s. per ton being paid for Scotch foundry iron delivered into the Birmingham district. There is some amount of continental pig iron coming in, but in no great weight. Continental billets have advanced in price and deliveries are very uncertain.

During September the production of pig iron fell to 12,500 tons, and only five furnaces remained at work. Steel production increased from 52,100 tons in August to 95,700 tons, owing to the increased coal supplies. The exports of iron and steel were 160,200 tons, and the imports reached the record figure of 445,700 tons.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Improved aluminium-silver alloys. W. Kroll. *Metall. u. Erz*, October (2), 1926, pp. 555-557 (in German). Discusses the effect of the replacement of copper by silver in self-hardening aluminium alloys.

The copper-beryllium alloys. M. G. Corson. *Brass World*, October, 1926, pp. 314-320. Demonstrates the utility of beryllium as a hardening agent for copper.

Electrical resistivity of aluminium-calcium alloys. J. D. Edwards and C. S. Taylor. *Metal Ind. (Lond.)*, October 15, 1926, pp. 359-360.

The constitution and structure of the commercial aluminium-silicon alloys. A. G. C. Gwyer and H. W. L. Phillips. *Engineering*, October 8, 1926, pp. 458-460, and October 15, 1926, pp. 492-494.

ANALYSIS.—The determination of very small quantities of iron. H. L. Smith and J. H. Cooke. *Analyst*, October, 1926, pp. 503-510.

The detection and estimation of small amounts of tungsten, molybdenum and thorium. W. Singleton. *Ind. Chem.*, October, 1926, pp. 454-457.

The estimation of calcium, sodium and lithium in the new lead alloys. E. Schürmann and W. Böhm. *Chem.-Zeit*, September 22, 1926, pp. 709-710 (in German).

The determination of gases in iron and steel. Part III. P. Klinger. *Stahl u. Eisen*, October 7, 1926, pp. 1353-1358 (in German).

COPPER.—The action of hydrogen on hot solid copper. C. S. Smith and C. R. Hayward. *Engineering*, October 22, 1926, pp. 520-522.

CORROSION.—Corrosion fatigue. A. P. Hague. *Metallurgist*, October 29, 1926, pp. 152-154. Discusses the reduction in the fatigue strength produced by corrosion pitting.

The effect of certain impurities in zinc upon its corrosion in acid and oxygenated solutions. W. S. Patterson. *J.S.C.I.*, September 24, 1926, pp. 325-330.

Corrosion tests on aluminium and aluminium alloys. *Metallurgist*, October 29, 1926, pp. 156-157.

FURNACES.—Selection of proper furnace insulation. M. H. Mawhinney. *Blast Furnace and Steel Plant*, October, 1926, pp. 426-431.

GENERAL.—Methods of growing large metal crystals. Part I. H. C. H. Carpenter. *Metal Ind. (Lond.)*, October 29, 1926, pp. 409-411.

Research in metallurgical literature. R. Rimbach. *Blast Furnace and Steel Plant*, September, 1926, pp. 396-399. Outlines the procedure to be followed.

Future developments in the light metals. F. C. Frary. *J. Ind. Eng. Chem.*, October, 1926, pp. 1016-1019.

IRON AND STEEL.—Future trends in iron and steel production. J. A. Mathews. *J. Ind. Eng. Chem.*, October, 1926, pp. 1021-1023.

The influence of silicon on the magnetic properties of steels. K. Daevs. *Z. Elektrochem*, October, 1926, pp. 479-481 (in German).

Recent improvements in hot-rolling mills. P. Brenier. *La Technique Moderne*, October 1, 1926, pp. 577-585 (in French).

The wire-drawing of steel. R. Galmard. *La Technique Moderne*, October 15, 1926, pp. 614-622 (in French).

A physical investigation into the cause of temper-brittleness. Part I. J. H. Andrew and H. A. Dickie. *Engineering*, October 29, 1926, pp. 553-555.

LEAD.—The treatment of lead residues. E. R. Thews. *Metal Ind. (Lond.)*, October 8, 1926, pp. 333-335. Describes the operation of the lead blast furnace.

REFRACTORIES.—Refractories for induction furnaces. M. Unger. *Metal Ind. (Lond.)*, October 29, 1926, pp. 416-417.

Refractories for melting pure metals. L. Jordan, A. A. Peterson and L. H. Phelps. *Metal Ind. (Lond.)*, October 15, 1926, pp. 367-369. Deals with iron, nickel and platinum.

TARNISHING.—The formation of protective oxide films on copper and brass by exposure to air at various temperatures. W. H. J. Vernon. *Chem. Soc. Trans.*, September, 1926, pp. 2273-2282.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

APPLEBY IRON CO., LTD.—Reg. September 28, £10,000 and further advances not ex. therewith £20,000 mortgage, to S. Cliff, Western Flatts, Wortley, Leeds; charged on properties at High Santon, Appleby, etc., and a sinking fund policy. *£1,050,000. November 24, 1925.

BRITISH METALS EXTRACTION CO., LTD., London, S.W.—Reg. September 30, £2,000 7th debentures, to Hon. G. W. P. Winn, 31, Montague Square, W., and others; general charge (except patents and secret processes). *£67,451 18s. 7d. January 6, 1926.

BURKE (WALTER) AND CO., LTD., Caythorpe, ironmasters.—Reg. October 12, mortgage to Bank; charged on close of land at Caythorpe. *Nil. March 13, 1926.

DUNFORD AND ELLIOTT (SHEFFIELD), LTD., iron merchants.—Reg. October 13, debenture to Bank; general charge. *£12,500 debenture. January 14, 1926.

HENRY (JOSEPH), LTD., Leeds, ironmasters. Reg. September 21, £5,000 1st debenture to Bank; general charge. *Nil. December 31, 1925.

KINGSDOWN AND TINCROFT MINES, LTD. (late KINGSDOWN (HEWAS WATER) TIN MINES, LTD.), London, E.C.—Reg. October 13, £10,000 2nd debentures (filed under sec. 93 (3) of the Companies (Consolidation) Act 1908), present issue £1,310; general charge (subject to trust deed dated November 27, 1922, etc.). *£25,000. December 31, 1925.

METALS REFINING CO., LTD., London, S.W.—Reg. October 5, £1,000 and £800 mortgages, to A. B. Falkner, Champion Hill, S.E., company director, and Mrs. A. Haman, 7, Oxford Terrace, Paddington; charged on lands in Yiewsley.

SHEEPBRIDGE COAL AND IRON CO., LTD., Chesterfield.—Reg. October 4, £2,000 debentures part of £750,000; general charge (except certain property). *£531,950. October 12, 1925.

WHITWELL (WILLIAM) AND CO., LTD., Thornaby-on-Tees, ironfounders.—Reg. September 21, £10,000 3rd debenture, to Bank; general charge (subject to prior debentures). *£200,000. May 31, 1925.

Satisfactions

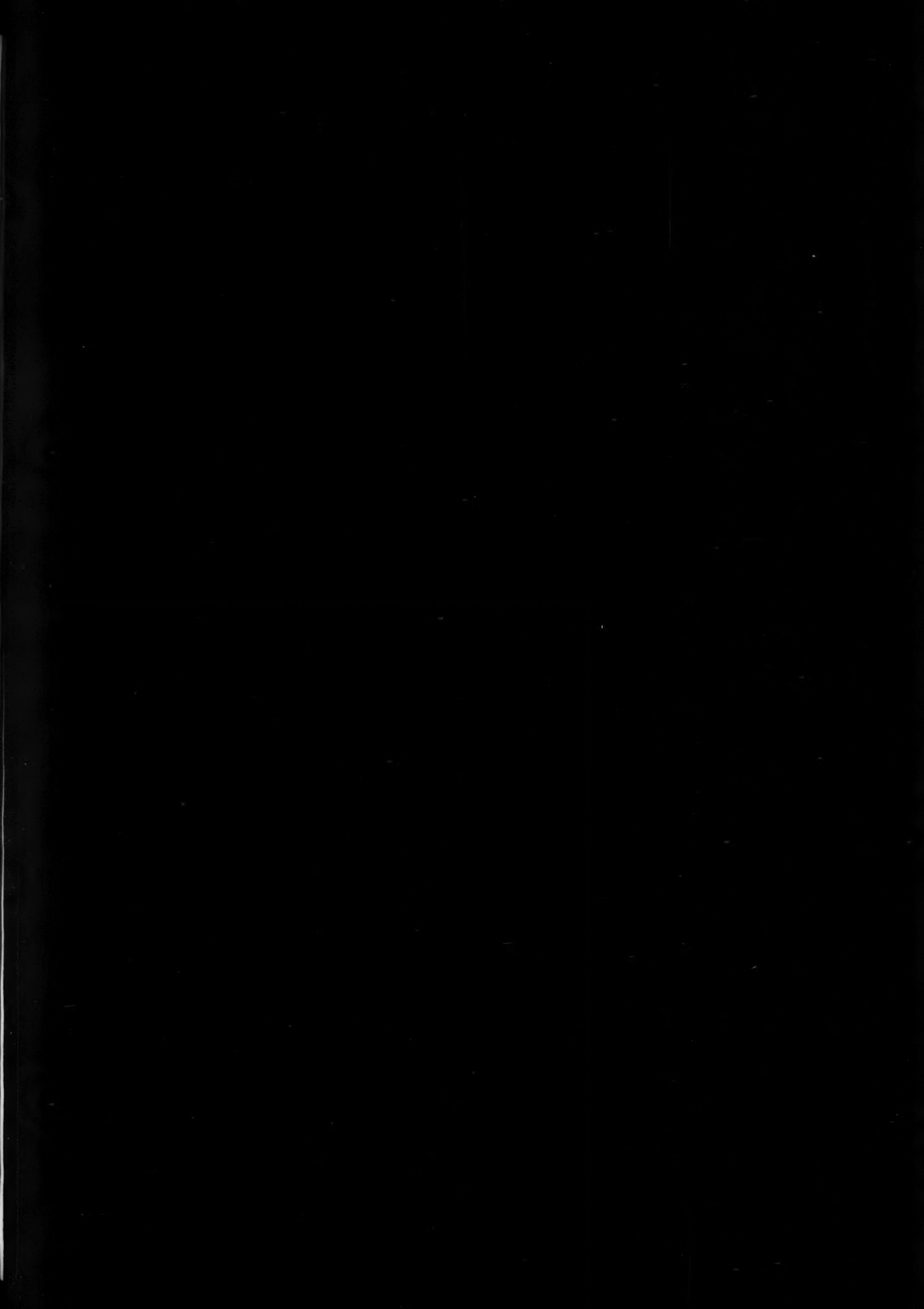
BLAENAVON CO., LTD., coal and ironmasters.—Satisfaction reg. September 25, £5,000, part of amount reg. August 24, 1911.

DUNFORD AND ELLIOTT (SHEFFIELD), LTD., iron merchants.—Satisfactions reg. October 13, £10,000 (not ex.) reg. December 1, 1903; and £2,500 (not ex.) reg. May 20, 1911.

GLAMORGAN HEMATITE IRON ORE CO., LTD., Cardiff.—Satisfaction reg. September 29, £2,451 5s., part of amount reg. July 6, 1921.

Prospecting by Flying Boat

The Natural Resources Intelligence Service at Ottawa reports that an amphibian flying boat in charge of Pilot C. S. Caldwell has returned to the High River, Alberta, after spending four months in the North-west Territories. The plane travelled between six and seven thousand miles and was used to transport a party of three engineers who prospected for minerals. The machine alights and arises with equal ease on land or water and the trip marks the first use of this type of machine as the mode of transport for prospecting in this area.



Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

The Properties of Duralumin

By S. H. Phillips

The following article gives an account of the properties and heat treatment of duralumin. The effect of the treatment on the resistance of duralumin to corrosion is considered, and also the general action of corrosion agents on the material. The results of a number of mechanical and other tests, illustrated by graphs, are given.

ALUMINIUM alloys are rapidly coming in vogue, increasingly so in the commercial fields. For aircraft work they have long been accepted, the Al-Cu-magnesium alloy being mostly in use in the latter sphere. The physical properties of "duralumin"—the trade name for a particular grade of aluminium alloy—are well known and need not be dealt with. It is thought, however, that the behaviour of this alloy under different heat treating temperatures and its resistance to corrosion when subjected to certain quenching media and attack from cer-

tain chemical agents, would be of interest to users. Often, in workshops where this alloy is being used, insufficient care is taken in ensuring accurate temperature control in annealing and normalising. This bears an important relation to corrosive action of the most dangerous type, generally known as intercrystalline attack.

The heat treating consists of bringing the material to within a certain temperature range and then quenching from that temperature. Immediately following this quenching process, the material is quite soft and ductile. Ageing spontaneously begins, being very rapid at first and gradually decreasing in intensity. At room temperature, this ageing will have been completed, to all practical purposes, within four days after quenching. The ageing effect consists of a considerable increase in tensile strength and hardness without appreciable loss in elongation. If the temperatures are correctly controlled resistance to corrosion is also increased. These ageing effects are permanent unless the material is again heated.

The detailed operating practice will depend upon the workshop condition. It must be at all times realised that what we are concerned with is the temperature of the metal itself and not necessarily the temperature of the furnace. The safest way, though not necessarily the cheapest way, would be to operate the furnace at the maximum metal temperature, i.e., 370° C., and leave the sheet in the furnace sufficiently long to be absolutely certain that all parts of the material have come to that temperature.

The chief merit of duralumin over other aluminium alloys lies in its high mechanical properties. These high properties are most noteworthy in the heat treated condition. Figure 1 shows the physical properties of duralumin with variation of heat treating temperatures. The loss in elongation at high temperatures is obvious. The graph illustrates the importance of accurate bath temperatures. Figure 2 illustrates the variation of elastic limit and yield point under a variable range of temperature.

The upper temperature limit must not exceed 480°–485° C., and must be uniformly applied for constant temperature condition throughout the piece. High temperature is very detrimental, whereas lower range effect is not so marked. After normalising, the material should not be disturbed within a period of four days, or the internal structure is so disturbed as to destroy the properties otherwise attainable. The tensile strength does not materially increase until near the end of the three-day period. The heat treatment of channels (long bars) is said to be best effected by use of a muffle gas furnace completely surrounded with gas flame. The heat

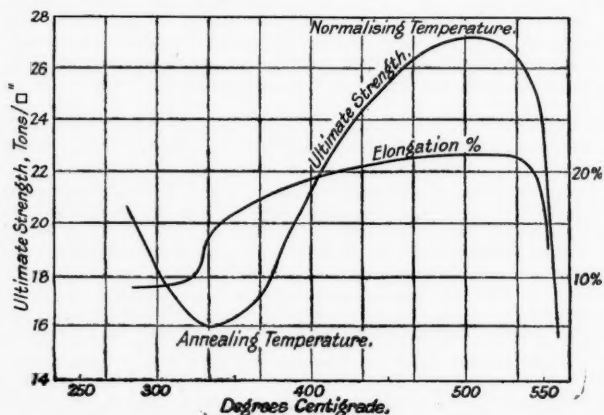


FIG. 1.—VARIATION OF STRENGTH OF DURALUMIN WITH TEMPERATURE OF HEAT TREATMENT.

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Heat Treatment

This heat treatment, commonly called "tempering," consists of heating the metal to 500° to 510° C. for from 7 to 30 minutes, depending upon the thickness of the sheet or bar, and then quenching in water at room temperature. If further work is to be performed on the metal it should be removed from the quenching bath immediately and the work performed as soon as possible. The technical heat treating range is actually about 480° to 520° C., but as temperature control is always a difficult matter, the first mentioned limits should

be used. In order to secure maximum properties the temperature range given above should be strictly observed. For securing this control, a bath of molten nitrates (either sodium or potassium nitrates or a mixture of both) gives excellent results, although an electric or fuel fired air furnace might be found satisfactory. Heating in a nitrate bath colours the material; this discoloration, however, is only superficial and does not affect the physical properties. Facilities should be such that the metal may be quenched with a minimum delay following removal from the furnace.

treatment of duralumin channels, long bars, or fittings at the ends, or only partial heat treatment, is a highly objectionable practice. If it is necessary to heat treat members in order to permit working them, either the whole piece should be heat treated or an allowance should be made for a great reduction in physical properties adjacent to the heat treated portion.

Tests have been carried out on strip duralumin, which

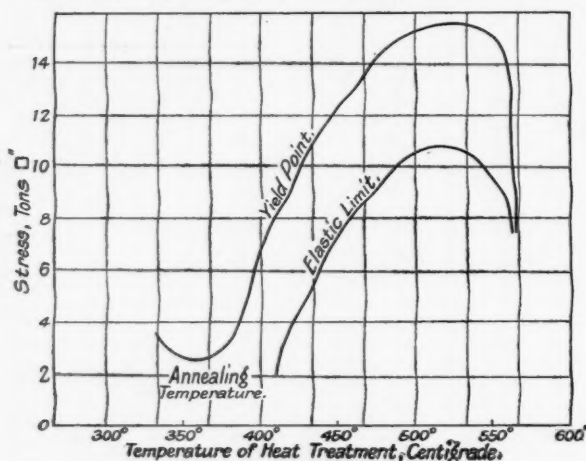


FIG. 2.—VARIATION OF YIELD POINT AND ELASTIC LIMIT OF DURALUMIN WITH TEMPERATURE.

had been previously heat treated and aged and immersed for half its length in the salt bath at quenching temperature, and then quenched in water, after ageing for approximately six days. Shore and Brinell readings were taken at intervals of one inch along its length. Results are shown in figure 3. The material showed uniform and satisfactory hardness along the heat treated portion up to slightly below the bath level. The hardness then rapidly fell off up to a point about 3 in. above the bath level, the lowest hardness corresponding approximately to the annealed condition of duralumin. From this point the hardness gradually increased up to the originally heat treated end.

Tensile test specimens were cut from points 7 in. and 15 in. respectively from the un-heat treated end, corresponding to the annealed and re-heat treated points of the strip. Test showed the following results:—

Condition.	Yield Pt. Tons per sq. in.	Ult. Str. Tons per sq. in.	Elong. %
Annealed....	7.81	17.6	12.0
Re-treated ..	9.8	28.5	20.5

This partial re-heat treatment may also tend to encourage corrosion at the points affected.

Chief early difficulties with channels were cracks caused by insufficient bending radius as compared with either aluminium or steel experience, poor design in drawing dies, and non-uniform heat bath throughout the entire length of the piece. Forging with duralumin has shown that this material can be more readily worked than steel, provided the density is not increased by the working, which will result in "density hardness."

Test Specimen

Most users of duralumin adopt a policy of testing about 10 per cent. of the materials received. Tensile test specimens are milled, not punched; hardened sheared edges give an apparent increase in tensile strength. Milling disturbs the original condition of the stock least. The Shore scleroscope is highly valued as an indicator for hardness in preference to Brinell for small gauge, and is most useful for duralumin. Practice method 1 is to take the mean of 5 differently positioned impacts, according to normal practice, or method 2, the mean of 5 consecutive impacts in the same spot. Method 2 is preferred and employed as a hardness criterion as it shows hardening with work done.

Some rolling mills have adopted the method of pulling long bars in order to straighten them after rolling. The writer does not think that definite conclusions have been arrived at as to the real effect of this straining process of

straightening. It is believed, however, that this straining would tend to produce a more uniform thickness since the convex side of the channel is thinner after rolling than the concave side; the stretching should equalise this, with a probable increase in strength without serious detriment to the elastic limit. The exact stress that should be used will have to be determined from tests. In any case it should be as low as possible and would probably be just above the elastic limits.

Since it is impossible to form these channels straight by rolling, it should be a practical operation to form them with a punch and die should straining prove injurious to the physical properties. It has been suggested that this punch process might be a cost- and time-saving operation. Data so far obtained showing the effect of strained and unstrained bars are given below.

	Unstrained.	Strained.
Y.P. stress per sq. in.	19.46	18.9
Ult. stress per sq. in.	23.4	22.5
% Elongation in 2 in.	13.9	12.8
Shore hardness.....	30.2	30.8
Modulus "E"	9832000	10484000

Influence of Heat Treatment on Corrosion

Quenching speed has a greater influence on resistance to corrosion than on physical properties. It has been shown that the physical properties of specimens quenched in cold water, boiling water and oil were practically the same, and that air-cooled specimens were nearly as good. There is no noticeable difference between specimens cooled in a fan blast and in still air. Air cooled specimens not exposed to corrosion retain their physical properties satisfactorily, as indicated by Shore and Brinell Tests, six months after heat treatment.

Duralumin, heat treated by water or oil quenching, although much more resistant to corrosion than if air quenched, is not immune and will be rendered worthless if the action is long continued. Corrosion is therefore a matter of time, and parts quenched by either method must have adequate surface protection. Air quenching might therefore be allowed under some circumstances on account of its great advantages from a manufacturing standpoint. Duralumin material exposed to the direct action of salt water will probably have to be quenched rapidly in some way to avoid excessive corrosion. Accelerated ageing after quenching, as by holding in an

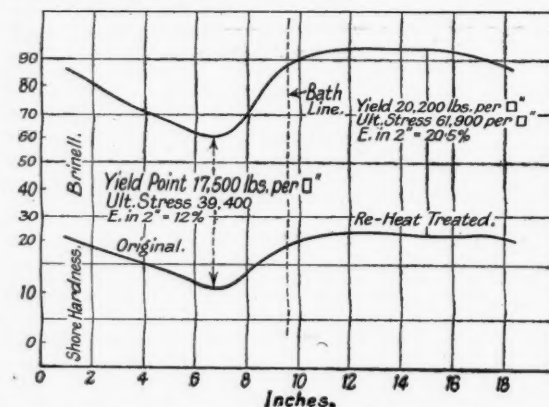


FIG. 3.—SHORE AND BRINELL TESTS.

oven or steam bath, or quenching in a hot medium, offers possibilities for further investigation.

The retention of hardness after quenching in water, oil, and air, for specimens $\frac{1}{4}$ in. thick, is shown below:—

Quenching medium.	5 days.	6 months.		9 months.	
		Shore.	Brinell.	Shore.	Brinell.
Water 15° C.....	26.8	27	93		
Water 100° C.....	26.2			29	93
Oil 20° C.....	27.0			27.5	93
Air Fan	27.0	27	93		
Air Still	26.0	27	93		

The rate of cooling in heat treating duralumin has a strong influence on the resistance to corrosion, the slowest cooled

pieces being the most severely attacked. The degree of corrosion, as indicated by the appearance of test specimens, after 30 days' exposure to salt water spray, may be graded as follows:—

Quenching Medium.	Degree of Corrosion.
(a) Water at 15° C. (60° F.)	Very slight. No scale or deep pitting.
(b) Water boiling	Slight, but more than (a), some pitting and flakes or scale.
(c) Oil at 20° C. (70° F.)	Same as (b).
(d) Air fan blast	Severe, badly scaled.
(e) Still air	Very severe. Deeply scaled.

The air-cooled specimens were rendered practically worthless, whereas the water and oil quenched specimens were not seriously affected at the end of the 30-day test. The speci-

mens cooled in the blast of an electric fan showed much less corrosion than those quenched in boiling water or oil.

Air quenched specimens appear to retain their properties (hardness) as well as oil and water quenched specimens.

Corrosion Tests on Duralumin by Spray¹

Probably, of all salts, calcium chloride is the most virulent when deposited on the surface of duralumin. The action is rapid, white deposits forming on unvarnished material immediately; and surface pitting (spot corrosion) will show within two or three days. A coat of spar varnish is a remarkably good protection against the action of calcium chloride and hydrochloric acid, and its use is thoroughly recommended on the surface of duralumin.

Some Advantages of Fuel Oil

From a Correspondent

AMONGST the many applications of fuel oil these which have shown the greatest progress of recent years are probably to be found in the marine, power engineering, and foundry industries. A few noteworthy cases may be cited which show the superiority which liquid fuel holds over solid combustible matter. The great Cunard liner *Aquitania* required the services of 350 men in the stoke hole when fired with coal, but only 84 when oil fuel was substituted. The efficiency of solid fuel ranges from 50 to 65 per cent., but with oil fuel the efficiency may be as high as 85 per cent. When burning fuel oil the cargo ship of a well-known American oil company took 61 days for a voyage which required 86 days when coal was burned. The consumption of fuel taken on the average is said to work out as 2 to 3 in favour of oil, whilst the indicated horse power developed shows an 18 per cent. improvement in the instance of the oil-fired vessel.

In the case of land steam plants the output of boilers can be augmented from 30 to 100 per cent. by the substitution of oil for coal. Efficiencies as high as 84.5 per cent. have been secured in this country with the marine multitubular type of boiler, employing fuel oil with the pressure system of oil burning. With locomotives the application of fuel oil has been largely retarded owing to the price demanded for it. Notwithstanding this, however, great progress has been made on the lines of finding the efficiency at which it could compare favourably with coal. In those outlying districts where a shortage of coal supply is experienced, liquid fuel should stand a better chance of being used. The ease with which oil can be handled demonstrates its superiority over solid fuel on locomotives as elsewhere. Oil may be handled from tank-cars to storage-tanks and thence to locomotives for a fraction of the cost which is required for the average handling of coal. The risk of accidents is very slight where liquid fuel is employed, since extinction may be made instantaneously. This property of immediate ignition and extinction materially assists any experimental work which it is desired to conduct on new burners, combustion chambers, etc.

Burners

The principal burners used for fuel oil are of three types and are operated either by air, steam, or pump pressure. This is done to break up the fuel, which has been rendered more fluid by heating coils in the fuel tank, into a finely atomised spray. The primary intention is to divide fuel into minute particles and to secure a correct air supply, so that thorough combustion is obtained. If there is an insufficiency of air, the flame and chimney top are smoky, which indicates a waste of fuel. An excess of air, on the other hand, is equally detrimental, and is to be avoided. The air-jet burner employs air as an atomising agent at pressures ranging from $\frac{1}{2}$ lb. to 50 lb. per square inch, but as a rule in practice air at a pressure of about 2 lb. per square inch and a temperature up to about 200° F. gives the most reliable results. In exceptional cases a higher pressure may be called for. Fuel oil should reach the burner nozzle at a temperature of approximately 110° F. The steam jet burner uses steam as an atomising agent at a pressure of 20 to 150 lb. per square inch, but with ordinary land boiler or locomotive practice, superheated steam at a pressure of about 50 lb. per square inch gives the

most satisfactory results. In both air and steam burners, further economies are secured if the air introduced for combustion is also preheated.

The pressure system of oil burning entails the assistance of heaters, pumps, and filters, on a system which may be outlined as follows. Fuel oil is sucked by means of the pump from storage-tanks through duplex suction strainers (one of which is cleaned out while the other is in operation), and is charged through steam-heated fuel oil heaters and duplex discharge strainers. These are similar in design and operation to suction strainers, and control valves to burners on furnace fronts and boilers. These valves control the number of burners in operation, and the quantity of fuel oil consumed per hour is generally controlled by the size of orifice in the burner nozzle.

Oil Furnaces

There are a vast number of industries using direct heat in which oil is displacing coal, coke, and gas firing, apart from the use of fuel oil for steam raising. Metallurgical and industrial processes, such as case-hardening, annealing, tempering, glass manufacture, brass melting, and the production of rivets and bolts, have introduced fuel oil, the use of which for some of the foregoing purposes was one of its first applications. At present oil furnaces have been brought to a very high standard of efficiency, and are being extensively employed both in this country and abroad. The following brief summary indicates the advantages realised in the use of oil for industrial purposes. There is a reduction in the cost of fuel required for a given amount of work, with more uniform results owing to a perfect control of furnace temperature; and a reduction in waste caused by imperfect work, breakage, and consequent loss of metal, according to the class of work on which the furnaces are employed. Individual heats can be run, and furnaces shut down, without waste of fuel, which saves time and reduces labour costs. As there are no ashes to dispose of, no cleaning out of furnaces is necessary after a day's work, and the whole manipulation of the furnaces is less troublesome to the operator. The calorific value of fuel oil is given at approximately 19,000 B.Th.U. per lb., which compares favourably with coal, which usually varies between 11,500 and 14,000 B.Th.U. per lb., depending upon the nature and quality of the coal.

In conclusion, another small point which is of great importance in the glass industry is that the gases formed by combustion are free from sulphur, which cannot be claimed for producer gas, which at present receives more extensive application.

Presentation to Professor Turner

A PRESENTATION was made to Professor T. Turner, who is retiring from the staff of Birmingham University, on Friday, at the University. It was made by Mr. Neville Chamberlain, and took the form of a photograph of the professor, to be hung permanently in the metallurgical department at Edgbaston; a bound volume containing the names of subscribers, together with an expression of appreciation of the services rendered to metallurgy by Professor Turner during his long career, and of the esteem in which he is held; and a motor-car for his personal use.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

A New Steel?

IN spite of the wide diffusion of knowledge, the daily Press, and, with one striking exception, the provincial section of it, is but indifferently served in regard to matters technical. The latest rumour flying about concerns an epoch-making discovery in steel manufacture which is going to place Germany *hors concours* amongst manufacturing nations. This sort of claim has been made before—even at home. Some years before the war some of the Sheffield papers aired an equally wonderful "discovery." A distinguished professor vouched for its "epoch-making" nature, and a celebrated alchemist in Victoria St., since deceased, endeavoured to exploit it. The ingredients of the new steel of that time were never fully disclosed; it was freely whispered, however, that sugar, or sawdust, or both, were employed in its manufacture. Like the White Knight's pudding, which, according to his own expert claim, was "a very good pudding," it is to be doubted whether the steel in question was ever *really* made. It will be well to await further details before forming an opinion on the new steel, which is said to be the result of an I.G. process. Even if, like the Bergius process for the hydrogenation of coal, it seems all right, on paper, it is hardly likely to revolutionise the industry. An interesting chapter might be written on folklore and superstition in metallurgy. In the days when South Staffordshire was still a great puddling district, adepts used to visit the local works in the endeavour to sell various medicines and dopes to the men to facilitate the metal "coming to nature." Imagination can go a long way in these things, and the will to believe may have lightened the labours of the puddlers, even if it did not wholly realise the promised results.

The Infinite Range of Alloys

No limits can be assigned to the possibilities of metallurgical science, beyond the one great limitation that no more can be got out of a given body than nature has originally endowed it with. Unless there had been nickel atoms present in the carbonyl which the genius of Mond applied to the process with which his name is associated, no nickel, so far as our knowledge extends, could have been derived from that process. We have not obtained industrial control of methods based upon the transmutation of metals, although even that may be in store for us some day. There are three iron carbonyls, but no Mond iron process. The bulk of our iron is still obtained by processes which are hundreds of years old; modernised and improved, but not different in principle. Those processes depend upon coal. Their economic success depends upon the price of coal. The outlook is not happy. The dice is heavily loaded against the British iron trade. On the other hand, the non-ferrous metals industries are far more favourably circumstanced, a curious fact for which it is difficult to find a satisfactory explanation seeing that those industries similarly consume coal, as fuel, although to a far smaller extent, and have, in addition, to import the bulk of the minerals required. The only solution would seem to be found in the fact that larger and larger proportions of non-ferrous metals and alloys are being employed in industry, relatively, that is, to iron and steel. The alloys, in particular, are being developed with bewildering rapidity, and new ones are announced almost daily.

Ultra Light Alloys

For better or worse, the phrase "ultra light alloys" has come to stay. Frequent references have been made of late to these alloys in the columns of this supplement because they are attracting a very large amount of attention. The latest advices from America and from the Continent show the continued interest taken in the possibilities of beryllium as an alloying metal. Although beryllium itself is an ultra-light metal—its exact specific gravity is either slightly under or slightly over that of pure magnesium, not having been finally and incontestably determined—its lightness is not the only feature which renders its employment an attractive possibility. Its great tensile strength and some of its other less known physical properties have led to many experiments

being made in the direction of alloying it with heavy and tough metals such as copper. The copper-beryllium alloys have been investigated and a provisional constitutional diagram proposed by M. G. Corson, who points out that the price of the metal in Europe is now only about £20 per pound, as compared with the "astronomical" prices prevailing but a few years ago. The 7.5 copper-beryllium alloy (and probably any alloy containing more than 4.8 per cent. of the element by weight) has a beautiful gold colour and is barely oxidisable even after heating to 750° C. for several hours. It is suggested that it would make good ornaments if cast or hot-stamped.

Hardness

WHAT is hardness? Nearly 200 years ago the first serious investigator of the nature of this evasive property declared that the definition and determination of hardness constituted an insoluble problem. There are all kinds of hardness, and they grade imperceptibly into one another, or interfere in such a manner as to neutralise, or mask, or even accentuate each other. A definition which will fit all is impossible to frame. The various methods of determining hardness have been challenged in succession, on the fundamental grounds of the difficulty of ascertaining what particular kind of hardness they are supposed to record. Bodies ranged in a sequence of relative hardness by one method, occur in a different sequence on the scale of some other method. Each of the existing hardness-testing machines and methods are challenged in turn by E. Esnault-Pelterie, in the current number of the *Revue de Métallurgie*. Yet with the incurable optimism of the enthusiast he propounds a fresh definition of hardness, and a fresh apparatus for ascertaining the particular kind of hardness he defines. So we have now the term Hertzian hardness added to the kinds, and the Esnault-Pelterie machine added to the devices which vex and perplex the soul of the physical-metallurgist.

The Hertzian Definition

THE Hertzian definition of hardness is, of course, no new thing, but its application for practical testing is novel. By way of clearing the ground, Esnault-Pelterie propounds a provisional definition: "Hardness is a property of the resistance of the external layers of solid bodies." It may, at the outset, be objected that this is a statement, and not a definition, or alternatively, if it be a definition, it defines nothing, for it fails to define the nature of the property, and thus contains a *petitio principii* and merely juggles with the implied major premise, by substituting for "hardness" the term "property." We all know that hardness is a property. There is, however, both an important truth and a dangerous fallacy enshrouded in the above statement. The property is directly ascribed to the external layer (or, to be meticulously accurate, in what is called in French, *la couche superficielle*). Thus we have, clearly recognised, the differentiation in physical properties of the external layer of a body. There is reason to suppose that *all* the physical properties of a surface differ from those of the subjacent layers. It is something gained to have this much clear. On the other hand, while the hardness of the superficial layer is probably *sui generis*, it must be directly affected and profoundly modified by the hardness of the subjacent layers, even admitting that these will differ in kind, or degree, or both, with the property possessed by the surface. However, the Hertzian definition proper does take this into consideration. Hence we arrive at the formula: "Hardness is the pressure existing at the centre of the circle of contact, at the moment when permanent deformation occurs." This is at least by way of being a tangible conception, and the method of obtaining it is ingenious, if complicated. It still leaves in obscurity the nature of the hardness, and its cause. Or are we to accept the metaphysical point that hardness does not exist until its effect be demonstrated?

British Metal Corporation Capital Rearrangement

THE British Metal Corporation, Ltd., has given formal notice of extraordinary general meetings to be held on December 8 and 23 for the purpose of passing special resolutions to rearrange the capital of the corporation. The

main effect of these, if passed, would be to subdivide each of the present issued £10 shares into 10 shares of £1 each with 12s. per share paid up; and to divide these shares into five ordinary shares of £1 each, and five 6 per cent. cumulative preference shares of £1 each, with rights as defined; to waive, for the present temporary purpose only, the provisions of the article of association governing the length of notice, amount, and intervals of calls; and to provide that any dividend declared in respect of the year 1926 shall be payable on the issued capital in its old form as at December 8. It is the intention of the directors, if these resolutions are passed, to call up the liability of 8s. per share, making it payable on January 1, 1927. The directors propose to issue 82,500 ordinary shares of £1 each, and 82,500 6 per cent. cumulative preference shares of £1 each to the corporation's associates in Australia and Burma. The issued and fully-paid capital of the corporation would then be 900,000 6 per cent. cumulative preference shares of £1 each, and 900,000 ordinary shares of £1 each. This rearrangement of the corporation's capital is in accordance with representations made by shareholders from time to time.

Protection of Aluminium

DURING the years 1921-24 a series of investigations on methods of protecting aluminium and aluminium alloys against corrosion were carried out on behalf of the Department of Scientific and Industrial Research by the Corrosion Research Committee of the Institute of Metals. The principal outcome of the investigations was the development of a method of protecting aluminium or its alloys by producing a strongly adherent film of aluminium hydroxide on the metallic surface by anodic oxidation. A secondary discovery of some interest and technical importance was that the aluminium so treated could be successfully dyed. The laboratory investigations were followed up by successful experiments on a larger scale at the Royal Aircraft Establishment, Farnborough, by arrangement with the Air Ministry; and the process, which is protected by patent (British Patents Nos. 223994/5, and foreign and colonial equivalents), is now being worked in this country by several firms under non-exclusive licences from the Department. The original work was carried out by Dr. G. D. Bengough and Mr. J. M. Stuart, and the Department of Scientific and Industrial Research has now issued an account of it in the form of a monograph entitled *The Anodic Oxidation of Aluminium and Its Alloys as a Protection Against Corrosion* (H.M. Stationery Office, pp. 40, price 1s. 3d.). The process consists of passing an electric current through a suitable bath—such as chromic acid—using the aluminium as anode and a carbon rod as cathode. Only aluminium or suitable aluminium alloys may be so treated.

German Iron and Steel Trades

THE year 1925 was generally characterised in Germany as one of extreme economic gravity, states the Report on the Economic and Financial Conditions in Germany 1925-26, recently issued by the Department of Overseas Trade. In spite of this the output of steel in the first six months of 1925 exceeded pre-war figures, and for the rest of the year, though a drop occurred, production was fairly well maintained. It is estimated that Germany consumed or retained for her own use about 85 to 90 per cent. of her pre-war requirements. Exports amounted to some 3 million tons. In regard to pig iron, Germany, with some 80 furnaces in blast, produced more pig iron than the United Kingdom with over double that number in operation, and the results show the large unit lay-out with which Germany is equipped. In order to preserve as far as possible the home market for themselves, the German iron and steel producers followed the course of granting rebates to the exporting finishers. The report goes on to state that during the period very great attention has been concentrated on the so-called "rationalisation" of production, that is, the operation of units of a group in such a way as to achieve the maximum efficiency of working. This line of development is well exemplified in the formation of the Ruhr Steel Trust, composed of a few of the most important works. Everywhere in the German metallurgical and engineering trades very serious study is being devoted to the efficiency of production; transport arrangements are being overhauled and brought into line with mass production programmes. The

technical re-equipment of the large steel works has been pressed forward, and plant not fitting in with the requirements of modern mass output ideas has been to all intents and purposes discarded or laid idle, so that the present-day steel units in operation are composite examples of the latest technical improvements. If the Ruhr Steel Trust proves flexible enough in practice (and the flexibility will largely be determined by the receptivity of the home market), it cannot be doubted that the fusion of interests will lead to general economies all round, and will enable the excellent geographical situation of some of its members to be exploited to full advantage.

Canada's Increasing Zinc Production

RECENT announcement of the resumption of the export of zinc concentrates by the Consolidated Mining and Smelting Company of Canada directs attention once more to Canada's increasing production of this metal. Canada is again apparently producing more zinc ore and concentrates in British Columbia than the present plant and refinery at Trail can take care of, notwithstanding that the capacity of this plant was increased during 1925 to a total of 200 tons of zinc per day. In September of that year the enlarged plant was able to handle the entire output of the company's properties, together with Customs ore being received, this being the ideal aimed at by the smelter management, but the present year has already seen the completion of a new 500 ton mill at Moyie, B.C., to re-treat the old tailings and mine dumps of the St. Eugene mine, while the capacity of the Sullivan mill is being increased from 3,000 to 4,000 tons of ore per day. Receipts of Customs ores are also increasing. The production of zinc at Trail for the first half of the year is reported as 29,849 tons, as against 15,711 tons during the first half of 1925. The total production of zinc in Canada in 1925, including the metal in concentrate exported, was 55,335 tons, as against 49,455 tons in 1924, and 30,208 tons in 1925. A total of from 70,000 to 75,000 tons appears to be in sight for 1926.

Canada has thus within ten years risen to the position of fifth place amongst the world's producers of zinc metal in refined form and to practically the same position from the point of view of production according to origin of ore. It is significant that this rapidly increasing production has come from those properties that have been in active operation for over ten years, and it is apparent that production may again be considerably accelerated when the various zinc ore deposits in British Columbia, Manitoba, Ontario, Western Quebec, Gaspé, Quebec, and in Cape Breton, Nova Scotia, now under exploration and development, reach the stage of commercial production.

Ferroalloys in America

AN increase of 24 per cent. in the shipments of ferroalloys from furnaces is shown for 1925. The shipments of ferromanganese in 1925 increased 9 per cent. and those of spiegeleisen increased 26 per cent. The average values per ton reported for ferromanganese and spiegeleisen at the furnaces in 1925 were, respectively, \$102.39 and \$25.10. The production of ferromanganese in 1925 was 259,780 gross tons, averaging 78.93 per cent. of manganese, and containing 205,046 tons of manganese (metal). In the production of ferromanganese in 1925 there were used 519,139 gross tons of foreign manganese ore, 34,942 tons of domestic manganese ore, 4,949 tons of iron ore, and 11,072 tons of cinder, scale, and scrap. The quantity of manganese ore used per ton of ferromanganese made in 1925 was 2.133 gross tons; in 1924 it was 2.186 tons; and in 1923 it was 2.243 tons.

Of the foreign manganese ore consumed in 1925, 207,238 gross tons was from Brazil and averaged 43.52 per cent. of manganese; Russia furnished 194,006 tons, averaging 48.17 per cent. of manganese; India, 68,326 tons, averaging 50.42 per cent.; Africa, 33,582 tons, averaging 46.97 per cent.; and the remainder was from Chile, China, Cuba, and Porto Rico and averaged between 42.44 and 52.75 per cent. of manganese. The average manganese content in the total foreign ore consumed in 1925 was 46.41 per cent. The improvement in metallurgy in the manufacture of ferromanganese is evidenced in 1925 by the recovery of 80.36 per cent. of the metallic manganese contained in all ore consumed, whereas during 1918 a loss of from 10 to 40 per cent. of the manganese contained in the ore was entailed in the manufacture of ferromanganese.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

SINCE our last report some progress has been made with regard to the entry of Great Britain into the European Steel Cartel. At the beginning of November a meeting of the National Federation of Iron and Steel Manufacturers was held at which representatives of practically every steel-making firm in the country were present; in fact, the attendance represented about 95 per cent. of the productive capacity of the country. The whole matter was discussed and the views of the leaders of the iron and steel industry were expressed. The tone of the discussion showed that the general opinion was in favour of participating in the Cartel, but it was naturally impossible to arrive at any definite decision; indeed, a decision was not possible at that meeting, as there were so many points on which information and assurances were required. Ultimately a committee of about 8 or 9 of the representatives of the leading makers was formed to consider the matter in all its bearings and to consult with the representatives of the European Cartel, and then report to a further meeting of the Federation.

If Great Britain Does Not Join!

There is one rather significant feature of the arrangement among the present members of the scheme. The surplus funds after paying expenses and compensation are to be distributed periodically to the countries from which they have been contributed, but these returns do not go back to the individual firms who originally paid them. They will be retained by the head organisation of each country, and although this is not stated in the agreement, it is understood that they will be retained to form a sort of fighting fund, to be used where necessary against those makers or countries which remain outside the scheme. This fact confirms the impression that if Great Britain does not join, there will be an organised attack on the export markets of the British steel industry, and even on the home markets. We have had experience of this kind of thing from individual continental nations in the past, and we know what a real menace it is; it is certain that under the new scheme the dumping would be even more severe. No doubt this point will have its due influence on the deliberations of the committee appointed by the Federation.

There are several difficulties to be overcome if a decision in favour of the scheme is reached, but they are not insurmountable. The basis on which the tonnage allocation would be made to Great Britain would have to be specially settled. In the ordinary way, the production of the first three months of this year would be taken as the basis, but this would be very unsatisfactory, as the steel works during that period were working very far from their full capacity, and during that period the export trade was at a very low level. To base the allocation on those figures would mean the perpetuation of a condition of partial employment all round. The British allocation would need to be somewhere in the region of 10,000,000 tons per annum. No doubt that would be arranged, as the Cartel cannot be a complete success unless Great Britain comes in, and the European members realise that.

Attitude of Re-Rollers

Another difficulty is the attitude of the re-rollers in this country, and that will not be easy to overcome. The re-rollers are a very important section of the steel trade, and they can make their weight felt. They purchase a large part of their supplies from the Continent, and they will not allow that source of supply to be interfered with either in quantity or in price without making a fight; yet they are bound to suffer along with the steel makers if Great Britain remains outside the Cartel. It should not be impossible for the two sections to come to some agreement on this matter, although it will require careful handling. It will be remembered that the application for the inclusion of the steel industry under the Safeguarding of Industries Act was strongly opposed by the re-rollers, and their opposition proved effective.

The third important obstacle is the lack of organisation of the British steel industry as a whole. The contributions from each country to the funds of the Cartel have to be made by the firms who are members, consequently any firms who remain outside are not only free from the levy, but they can

produce as much steel as they wish or may be able to, and if their efforts result in the output of the country exceeding the quota allowed by the Cartel, the fine would have to be paid by the other makers who were members. Nevertheless, when it is pointed out that about 97 per cent. of the output of Great Britain comes from 36 firms, it will be seen that it should not be impossible to organise the industry in such a manner as will enable the country to join the Cartel if it is found desirable to do so.

It will take a considerable time for the committee to carry out its investigations.

The Coal Position

The position in regard to the coal dispute has changed considerably since last month, although the development has been along lines which were expected. The Miners' Federation has failed to achieve its declared object, and the settlement of the dispute has been finally referred to the districts, each of them making the best terms possible with the owners. Only four districts at the moment of writing remain unsettled—South Wales, Yorkshire, Northumberland, and Durham. All the other districts have come to terms, and practically as many men are at work as can be set on at the present time. It was pointed out some time ago that even when the dispute was settled there would be about 200,000 men for whom employment could not be found, and this number does not appear to be far out. In the four districts just mentioned negotiations are proceeding, although the men are still stubborn. However, it is not likely that the stoppage will be protracted much longer.

Steel Production and Fuel Prices

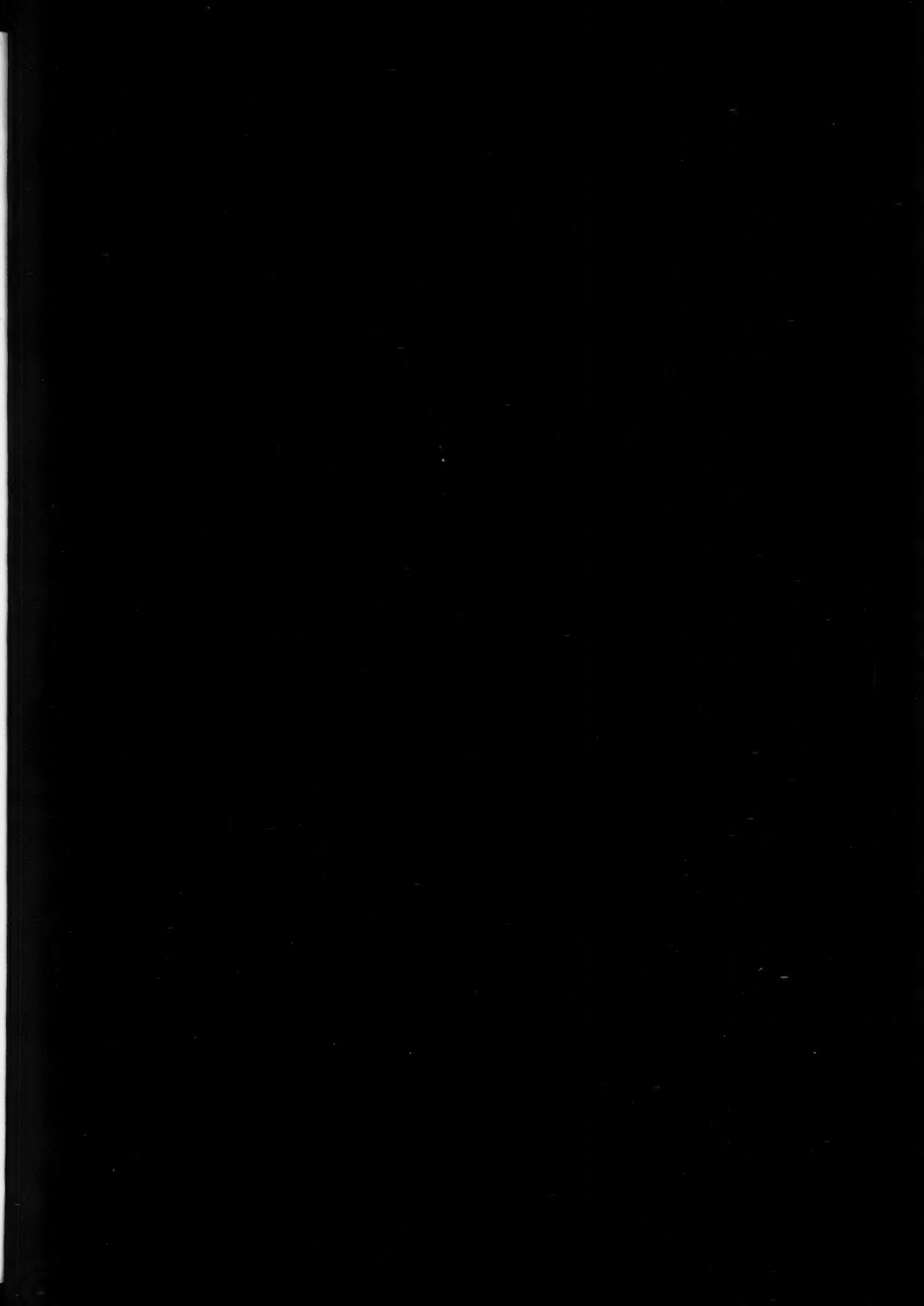
There is now little hope of any great weight of steel being made before the New Year. Supplies for the works will not be available until some days after the collieries reopen. Moreover, the coke ovens on which the blast furnaces are dependent will not be turning out their normal quantity and quality of coke until two or three weeks after they get supplies of slack from the collieries. Most of the blast furnaces which were damped down at the beginning of the stoppage have had to be raked out and they will need relighting; and in many cases repairs will be necessary. After the blast furnaces are producing iron some little time will elapse before the steel furnaces and the rolling mills are running. In a few cases, where the works have sufficient pig iron in stock, a start may be made before Christmas, but it will be getting on for the middle of January before the output of steel is anything like normal.

There is still some doubt as to the price of fuel after the strike is settled. Coal has been quoted at various prices ranging from 1s. 6d. to 2s. 6d. per ton over pre-strike figures, for long term contracts, but the coke makers do not seem willing to quote at present. There is bound to be some advance in coke as well as coal, but both the colliery owners and the coke makers realise that this advance must be kept within reasonable limits, otherwise the steel works must remain closed.

Pig Iron Shortage

There is likely to be a shortage of pig iron in the near future. Stocks have been depleted, and as regards basic iron for steel making it is known that the supply is far short of the possible demand from the steel works. Quotations for basic pig iron are now about 20s. per ton above the pre-strike figure, and even higher prices may be realised when the demand becomes effective. Steel prices are quoted at about the same advance over the pre-strike figures, but already some of the makers are offering to book contracts at the official advance of 10s. or thereabouts. This applies particularly to plates, and it is reported that quotations are being made from the new works at Appleby for delivery next year. For the present the competition from that quarter will not be very effective, but later on it will become more serious.

The production figures for October show that only five blast furnaces were in operation, and the output of pig iron was 13,100 tons, compared with 473,700 tons in the same month last year. The output of steel was 92,900 tons, compared with 652,400 tons last year.



Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Treating Ores

I. BASHILOFF, MOSCOW, Russia, describes a process for removing calcium carbonate from complex ores containing it, which consists in digesting the powdered or calcined ore with an ammonium salt of an acid which does not form an insoluble calcium salt. When using ammonium chloride, calcium chloride is formed, ammonia and carbon dioxide being evolved. The latter are led into a solution of calcium chloride from a previous operation, whereupon calcium carbonate is precipitated and a solution of ammonium chloride obtained for further use. The application of the process to a mineral containing 80 per cent. of calcium carbonate, together with uranium, vanadium, copper, and iron, is described. See Patent Specification 257,084, dated July 31, 1925.

Cast Iron

ACCORDING to a Patent application by F. W. Corsalli, Berlin, cast iron of low carbon content is obtained by smelting the iron in a cupola furnace while using such a high blast pressure, or such addition of oxygen to the blast, that the whole of the coke is burnt completely to carbon dioxide. See Patent Application 254,727, having the International Convention date June 30, 1925.

Gold Alloys

THE General Plate Co., Attleborough, Mass., U.S.A., describe a series of gold alloys containing 25 to 85 per cent. of gold, 1 to 10 per cent. of aluminium, and sufficient base metals to render them malleable and ductile. Alloys of the following composition are mentioned: (a) 14 parts of gold, 6 parts of copper, 3 parts of zinc, and 1 part of aluminium; (b) 58 parts of gold, 5 parts of aluminium, and 37 parts of copper or copper along with zinc, nickel or silver. See Patent application 257,891, having the International Convention date, September 4, 1925.

Electro-deposition of Chromium

Two further methods appear for the deposition of metallic chromium by electrolysis. According to the method of the Chromium Products Corporation, New York, the electrolyte contains chromium in two stages of oxidation, together with a small amount of a soluble salt of a metal which is more electro-positive than chromium and is not therefore deposited. A suitable bath contains 325 grams per litre of chromic acid, 12 grams of chromium hydroxide and 6 grams of crystallised ferrous sulphate. Electrolysis is effected at 35° to 45° C., with a current density of 0.05 to 0.2 amp. per sq. cm. Insoluble anodes of lead or soluble anodes of chromium or its alloys may be used. The ferrous sulphate can be replaced by nickel sulphate or sulphates or chlorides of cadmium, tin, lead, antimony, bismuth, copper, or mercury. See Patent application 258,219, having the International Convention date, September 10, 1925.

In the method of the Metropolitan-Vickers Electrical Co. a chromic acid electrolyte is also used with an addition of sulphuric acid or a soluble sulphate such as that of sodium or chromium. The anode consists of lead or lead peroxide and the electrodes are separated by 0.5 to 1 in., the current density being 0.3 to 0.6 amps. per sq. in. The plating of ferrous or non-ferrous metals or alloys can be effected. See Patent application 258,242, having the International Convention date, September 12, 1925.

Zinc

ACCORDING to a patent application by the Electrolytic Zinc Co., of Australasia, Melbourne, Australia, zinc sulphate solutions intended for electrolytic treatment for recovery of zinc are freed from salts of copper, cadmium, silver, arsenic, and antimony by agitating them with zinc dust out of contact with air. The exclusion of air is necessary to prevent reoxidation of the metallic cadmium precipitated. The zinc sulphate solution is prepared from roasted ore by treatment with spent electrolyte, and freed from iron, etc., by means of limestone; it is then mixed with the necessary zinc dust and passes continuously through a horizontal cylinder fitted with an agitating device; most of the excess of the heavier zinc particles is removed by a centrifugal device and returned

to the system, while the smaller particles of copper, cadmium, etc., pass away with the liquid and are collected in filter presses. See Patent application 258,575, having the International Convention date, September 17, 1925.

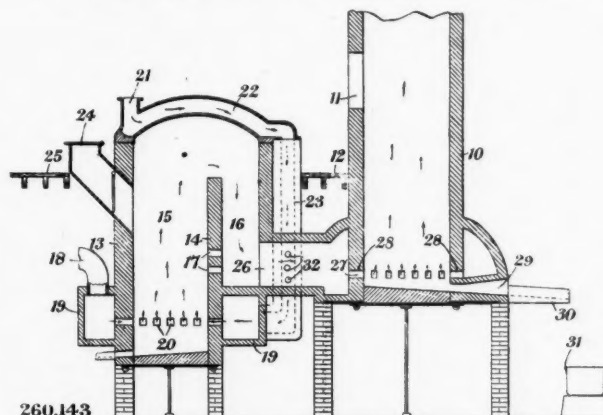
Steel

W. AND H. MATHESIUS, Charlottenburg, Berlin, produce a mild steel in open-hearth furnaces by melting malleable scrap, alone or mixed with pig iron in amount not exceeding 20 per cent., a temperature of 1,900° C. being used. A steel free from oxide is obtained though the usual boiling period is omitted. Steel alloys containing silicon, chromium, manganese or vanadium can be obtained by making the appropriate additions to the bath. See Patent application 258,835, having the International Convention date, September 22, 1925.

In the hardening of steel bodies it is often required to quench them at the point of decalescence. As this is also the point at which the metal loses its magnetic properties this property can be used to release the objects to be quenched when they have attained the temperature at which decalescence occurs. P. M. Salerni, of Upper Sydenham, London, describes apparatus for this purpose. An electromagnet supports the objects inside a vertical electrically heated tube; when they have attained the temperature at which magnetic properties disappear they fall from the magnet into a quenching bath. Large objects may be partly supported by a counterbalanced pivoted tray so that a smaller magnet will suffice. Arrangement may be made to retain the object within the furnace for a predetermined time after its release by the magnet. See Patent No. 260,026, having the date July 16, 1925.

Melting Iron

Y. A. DYER, of U.S.A., describes a method of melting iron for casting according to which the metal is placed in the melting cupola together with only a small part of the necessary fuel, the heating being mainly effected by combustion gases, containing excess of oxygen, from a furnace in which fuel is burned. In the apparatus shown in the figure fuel is burned



260,143

in the chamber 15, preheated air being supplied via the pipe 22 and the openings 20. The combustion gases pass by the passages 16 and 26 and the openings 28 to the melting cupola 10, in which the metal is placed in thick layers, with alternating thin layers of fuel. Some air or oxygen may be introduced directly into the heating gases via the holes 32. See Patent No. 260,143, having the date January 25, 1926.

Hafnium and Zirconium

THE N.V. Philips' Gloeilampenfabrieken, Eindhoven, Holland, find that hafnium and zirconium can be precipitated in a ductile form upon wires heated in the vapour of the iodides provided that the metals are very pure and that the temperature exceeds 1,750° C. in the case of the former metal and 1,600° C. in the case of the latter. The metals can be purified by preliminary deposition upon a heated wire from the vapours of their iodides; they are then introduced, together with iodine, into a vessel which can be exhausted and heated and which contains the heated wire upon which the ductile metal is to be deposited. See Patent No. 260,062 (communicated to W. J. Tennant), having the date August 7, 1925.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Improved aluminium alloys. W. Kroll. *Metall u. Erz*, November (2), 1926, pp. 613-616 (in German). Discusses the replacement of silicon by beryllium.

The mechanical properties of the binary aluminium-beryllium alloys. W. Kroll. *Metall u. Erz*, November (2), 1926, pp. 616-618 (in German).

The system aluminium-calcium-silicon. G. Doan. *Z. Metallkunde*, November, 1926, pp. 350-355 (in German). A description of experiments aiming at the improvement of aluminium.

The production of ceriron. H. Suchanek. *Chem.-Zeit.*, October 27, 1926, pp. 805-807 and November 10, 1926, pp. 848-850 (in German).

The constitution and the physical properties of the alloys of cadmium and zinc. C. H. M. Jenkins. *Engineering*, November 12, 1926, pp. 614-616.

BERYLLIUM.—The preparation of beryllium. W. Kroll. *Metall u. Erz*, November (1), 1926, pp. 590-594 (in German). Relates particularly to the replacement of silicon by beryllium in aluminium alloys.

CORROSION.—The ferroxy indicator in corrosion research, with special reference to the controversy regarding the cause of pitting. U. R. Evans. *Metal Ind. (Lond.)*, November 19, 1926, pp. 481-482, and November 16, 1926, pp. 507-508.

Boiler corrosion and possible combative measures. W. M. Barr and R. W. Savidge. *Chem. Met. Eng.*, October, 1926, pp. 607-608.

ELECTRO-DEPOSITION.—The form of electrolytically separated metals. F. Foerster. *Z. Elektrochem.*, November, 1926, pp. 525-534 (in German).

GENERAL.—The mechanism of the fatigue failure of metals. H. F. Moore. *J. Franklin Inst.*, November, 1926, pp. 547-568.

Resistance of metals to nitric acid. J. G. Thompson. *Chem. Met. Eng.*, October, 1926, pp. 614-616.

Metals for service at high temperatures. H. J. French. *Chem. Met. Eng.*, October, 1926, pp. 591-593.

IRON AND STEEL.—Hair-line cracks in nickel-chromium steel. R. H. Greaves. *Metallurgist*, November 26, 1926, pp. 167-171. A general discussion.

The transformations of hardened steel by tempering. H. Hanemann and L. Traeger. *Stahl u. Eisen*, November 4, 1926, pp. 1,508-1,514 (in German).

The embrittlement of black heart malleable iron resulting from heating overstrained material. R. D. Allen. *Trans. Amer. Soc. Steel Treating*, October, 1926, pp. 630-637.

Facts and principles concerning steel and heat treatment. Part IX. H. B. Knowlton. *Trans. Amer. Soc. Steel Treating*, October, 1926, pp. 638-656. Covers the fundamentals of annealing, hardening, tempering, etc., of low and medium carbon steels.

A physical investigation into the cause of temper-brittleness. J. H. Andrew and H. A. Dickie. *Engineering*, October 29, 1926, pp. 553-555, and November 5, 1926, pp. 582-584.

Caustic embrittlement of steel. S. W. Parr and F. G. Straub. *Chem. Met. Eng.*, October, 1926, pp. 604-607.

LEAD.—The treatment of lead residues. Part II. E. R. Thews. *Metal Ind. (Lond.)*, November 12, 1926, pp. 457-458. Concludes the description of the lead blast furnace operation.

MAGNESIUM.—Magnesium and its alloys. W. R. D. Jones. *Metal Ind. (Lond.)*, November 5, 1926, pp. 433-436, and November 12, 1926, pp. 459-461 and 463. An exhaustive summary of the subject.

WASTE RECOVERY.—The recovery and use of waste materials. J. B. C. Kershaw. *Ind. Chem.*, November, 1926, pp. 485-488. Describes the treatment of mining and metallurgical wastes.

Smelting secondary aluminium and aluminium alloys. Part V. Oxidation on smelting and its prevention. R. J. Anderson. *Metal Ind. (N. York)*, November, 1926, pp. 455-457. Deals with the reclamation of aluminium scrap.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

ALUMINIUM CORPORATION LTD., London, S.W. Registered November 1, £29,100 C debentures part of £500,000; general charge. *£1,204,148. November 18, 1925.

BRITISH GRIFFIN CHILLED IRON AND STEEL CO., LTD. (late BRITISH CHILLED IRON AND STEEL CO., LTD.), Barrow-in-Furness. Registered October 25, £1,000 debentures (ranking in priority to £1,000 2nd debentures dated September 15, 1925); general charge. *£7,000. March 3, 1926.

EBBW VALE STEEL, IRON AND COAL CO., LTD. Registered November 1, charge, to Barclays Bank, Ltd., securing all moneys due or to become due to the Bank; charged on certain railway wagons and agreements for hire of wagons, etc. *£781,200 and £573,000 bankers charge. July 13, 1926.

KINGSDOWN AND TINCROFT MINES, LTD. (late KINGSDOWN (HEWAS WATER) TIN MINES, LTD.), London, E.C. Registered October 19, £6,000 2nd debentures, part of £10,000; general charge. *£25,000. December 31, 1925.

SHEEPBRIDGE COAL AND IRON CO., LTD., Chesterfield. Registered October 30, £2,500 debentures part of £750,000; general charge (not including uncalled capital and certain property). *£531,950. October 12, 1925.

WEARDALE STEEL, COAL AND COKE CO., LTD., Spennymoor. Reg. October 21. Trust Deed dated October 8, 1926 (supplemental to trust deed dated October 31, 1899, securing £400,000 debenture stock); charged on certain leases relating to coal, properties, etc., at Hedley Hill, &c. *£287,302 (and certain guarantees secured by a 2nd charge). December 11, 1925.

Satisfaction

QUIRK BARTON AND CO., LTD., London, E.C., lead manufacturers. Satisfactions registered October 27, £19,074, registered August 11, 1911, March 8, 1912, March 20, 1912, March 29, 1912, May 21, 1912, February 7, 1913, February 19, 1913, and July 14, 1913, also November 11, £44,000, balance of amount registered March 20, 1912.

Russia's Iron

ACCORDING to the *Bergwerkszeitung*, the chief organ of the Ruhr mining industry, Russia is the richest of all countries in iron. The ore deposits discovered in the Kursk region form a large system, at an average of 400 yards below the surface and about 200 miles long. It is estimated that this system alone, which is only one of several, contains 630,000,000 tons of pure iron in high-grade ores. The total amount of ore in the newly discovered deposits is estimated at about 16,000 to 20,000 million tons. The German journal attaches great importance to these discoveries. Germany still obtains some of her iron ore from Lorraine, although Lorraine deposits will at the present rate of exploitation be exhausted in 50 years, and are of such poor quality that in Russia or America they would not be exploited at all, and Germany has to import great quantities of high-grade ore from Sweden and Spain. The Russian deposits are favourably situated near the sea or waterways. The *Bergwerkszeitung* recommends an agreement by which Germany should become the chief market for Russian ore while in return she would supply Russia with technical equipment, with organisation methods and with expert personnel for the exploitation of these vast deposits.



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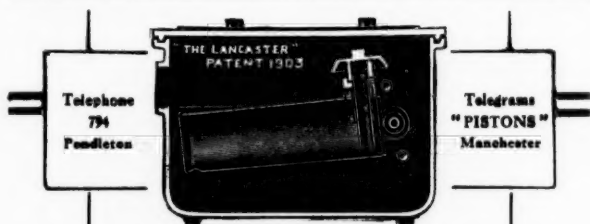
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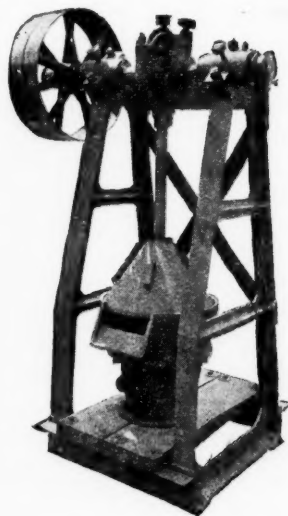
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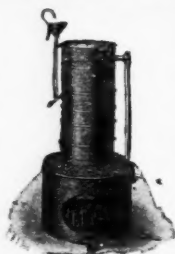
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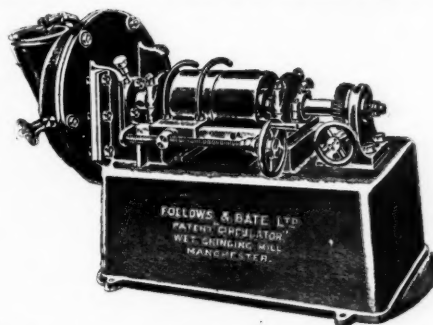
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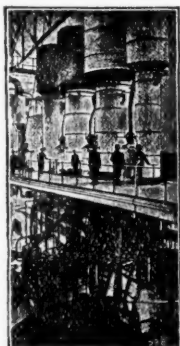
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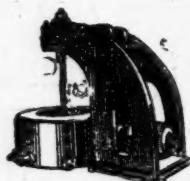
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